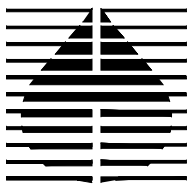


SEPTEMBER 23, 2016

DRAFT

PRE-DESIGN INVESTIGATION WORK PLAN
NORTHERN EXTRACTION AND CENTRAL EXTRACTION AREAS
OPERABLE UNIT 2
OMEGA CHEMICAL CORPORATION SUPERFUND SITE
LOS ANGELES COUNTY, CALIFORNIA

PREPARED FOR:
SETTLING WORK DEFENDANTS



HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

PRE-DESIGN INVESTIGATION WORK PLAN
NORTHERN EXTRACTION AND CENTRAL EXTRACTION AREAS
OPERABLE UNIT 2

OMEGA CHEMICAL CORPORATION SUPERFUND SITE
LOS ANGELES COUNTY, CALIFORNIA

TABLE OF CONTENTS

Section	Page
ACRONYMS/ABBREVIATIONS/COMMON TERMS	iv
1. INTRODUCTION	1
1.1 Objectives	1
1.2 Description of Remedial Action in the NE/CE Area.....	3
1.2.1 Remedial Design Work Area	3
1.2.2 Extraction Wellfields	3
1.2.3 Treatment System(s)	4
1.2.4 Treated Water End Use	4
1.2.5 Institutional Controls.....	5
2. SITE BACKGROUND.....	6
2.1 History	6
2.2 Regulatory History Summary	7
2.3 Site Investigations.....	8
2.4 Geology and Hydrogeology.....	8
2.5 Groundwater Chemistry.....	10
2.5.1 Constituents.....	12
2.5.2 Distribution	12
3. DATA NEEDS AND USES	15
4. SCOPE OF PRE-DESIGN INVESTIGATION.....	17
4.1 Task 1: Access and Early Water Level Monitoring.....	17
4.1.1 Access	17
4.1.2 Early Water Level Monitoring	18
4.2 Task 2: Exploratory Borings and Deep Monitor Wells in NE/CE Area.....	18
4.2.1 Install Exploratory Borings and Deep Monitor Wells	18
4.2.2 Initial and Confirmation Sampling.....	19
4.3 Task 3: NE/CE Area Monitor Wells.....	19

TABLE OF CONTENTS (continued)

Section	Page
4.3.1 Install Monitor Wells	19
4.3.2 Initial and Confirmation Sampling.....	20
4.4 Task 4: Primary ReInjection Area Monitor Wells.....	20
4.4.1 Access	20
4.4.2 Install ReInjection Area Monitor Wells	21
4.4.3 Initial and Confirmation Sampling.....	21
4.4.4 ReInjection Evaluation	21
4.5 Task 5: Hydraulic Testing	21
4.5.1 NE/CE Area PDI Monitor Wells.....	22
4.5.2 Phase 1 ReInjection Area Monitor Wells.....	22
4.5.3 Phase 2 Pilot Injection Test.....	23
4.6 Task 6: PDI Groundwater Monitoring.....	23
4.6.1 Water Level Monitoring.....	24
4.6.2 Water Quality Monitoring.....	24
4.6.2.1 Quarterly Monitoring	25
4.6.2.2 Final Monitoring	25
4.7 Task 7: PDI Evaluation Report.....	25
5. INVESTIGATION-DERIVED WASTE.....	26
6. PROJECT ORGANIZATION, ROLES AND RESPONSIBILITIES.....	27
6.1 EPA Project Manager	27
6.2 EPA Project Quality Assurance Officer	27
6.3 SWDs' Project Coordinator	27
6.4 Pre-Design Investigation Implementation Team	27
6.4.1 PDI Project Manager.....	28
6.4.2 Additional Team Members	28
6.5 Pre-Design Tasks	29
7. HEALTH AND SAFETY.....	30
8. DATA MANAGEMENT	31
9. PRE-DESIGN INVESTIGATION MILESTONES	32
10. REFERENCES	33

TABLE OF CONTENTS (continued)

LIST OF TABLES

Table 1:	Main Chemicals of Concern and Key Treatment Constituents
Table 2:	Summary of Correlation between Pre-Design Investigation Requirements and Planned Tasks
Table 3:	Existing and Pre-Design Investigation Water Level Monitoring Program
Table 4:	Pre-Design Investigation Exploratory Borehole and Monitor Well Summary
Table 5:	Existing and Pre-Design Investigation Groundwater Sample Collection
Table 6:	Groundwater Analyte Lists

LIST OF FIGURES

Figure 1:	Site Location
Figure 2:	Remedial Design Work Area
Figure 3:	Land Use In and Around OU2
Figure 4:	Santa Fe Springs Oil Field
Figure 5:	Generalized Hydrostratigraphic Column, Coastal Plain of Los Angeles County
Figure 6:	Main Geologic Features
Figure 7:	Historical Groundwater Hydrographs
Figure 8:	Pre-Design Investigation Tasks
Figure 9:	Summary of Pre-Design Investigation Activities

LIST OF APPENDICES

Appendix A:	Data Gaps Analysis
Appendix B:	Data Quality Objectives
Appendix C:	Field Sampling Plan
Appendix D:	Quality Assurance Project Plan
Appendix E:	Health and Safety Plan

LIST OF ACRONYMS/ABBREVIATIONS/COMMON TERMS

2010 FS	August 2010 OU2 Feasibility Study
2010 RI	August 2010 OU2 Remedial Investigation
2011 ROD	OU2 Interim Action Record of Decision, dated September 20, 2011
2016 CD	Consent Decree lodged April 20, 2016 covering Operable Unit 2 at the Omega Chemical Corporation Superfund Site
AOP	Advanced oxidation process
bgs	Below ground surface
CDM Smith	CDM Smith, Inc.
CDWR	California Department of Water Resources
CE Area	Central extraction area (The location of the CE area is depicted in the 2016 CD, Appendix C as the area between the NE and Telegraph Road.)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCs	Chemicals of Concern
COPCs	Chemicals of Potential Concern
DQOs	Data Quality Objectives
Day	Day means a calendar day unless expressly stated to be a working day. A working day is a day other than a Saturday, Sunday or federal or state holiday.
DTSC	California Department of Toxic Substances Control
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FSP	Field Sampling Plan
Geosyntec	Geosyntec Consultants
gpm	Gallons per minute
H+A	Hargis + Associates, Inc.
HASP	Health and Safety Plan

DRAFT

LIST OF ACRONYMS/ABBREVIATIONS/COMMON TERMS (continued)

HHRA	Human Health Risk Assessment
ICIAP	Institutional Controls Implementation and Assurance Plan
ICs	Institutional Controls. (ICs are non-engineering controls that will supplement engineering controls to prevent or limit potential exposure to hazardous substances, pollutants, or contaminants at the Site related to the Work and to ensure that the portion of the ROD applicable to the Work is effective.)
IDW	Investigation-derived wastes
IX	Ion exchange
Key Treatment Constituents	Treatment constituents that may require treatment to meet discharge requirements associated with end-use (reInjection, spreading basin, reclaim). The Key Treatment Constituents are considered during the RD based on end use.
LE Area	Leading Edge Area of OU2 is the area in the 2016 CD, Appendix C that is south of the CE Area
Main COCs	13 COCs identified in the ROD as “main COCs” and listed in Table 1. Includes eleven VOCs, 1,4-dioxane, and hexavalent chromium. The Main COCs are included in the COC list for the RD.
MCLs	Maximum Contaminant Levels (EPA and California)
msl	Mean sea level
NE Area	Northern extraction area (The location of the NE area is depicted in Appendix C of the 2016 CD as an area north of the CE)
NE/CE Area	A portion of the area of the groundwater contamination identified by EPA as OU2 in its 2011 ROD. The NE/CE Area is bounded by the OU2 boundary as depicted in the 2016 CD, Appendix C and the area north of Telegraph Road. It includes the NE and CE areas as depicted in the ROD as well as the northern portion of the LE area as depicted in the ROD.
NF	Nanofiltration
NL	Notification Level, California State Water Resources Control Board
O&M	Operations and Maintenance
OFRP	Oil Field Reclamation Project

LIST OF ACRONYMS/ABBREVIATIONS/COMMON TERMS (continued)

Omega Property	The property formally owned by the Omega Chemical Corporation, encompassing approximately one acre, located at 12504 and 12512 East Whittier Blvd, Whittier, California. OU1 and OU3 are addressing soil, groundwater, and soil vapor source control at the Omega Property.
OU	Operable Unit, a discrete action that comprises an incremental step in the remediation of a contaminated site.
OU2	Operable Unit 2, the contamination in groundwater generally downgradient of Omega Property, much of which has commingled with chemicals released at other locations into a regional plume containing multiple contaminants which, when considered in total, is more than four miles long and one mile wide. The OU2 boundary is depicted in the 2016 CD, Appendix C.
PC	Project Coordinator, an individual who represents the SWDs and is responsible for overall coordination of the Work.
PDI	Pre-Design Investigation
PDIWP	Pre-Design Investigation Work Plan
Performance Standards	The cleanup levels and other measures of achievement of the remedial action objectives, as set forth in the SOW, Paragraph 1.3(c).
PRPs	Potentially Responsible Parties
QA	Quality assurance
QAPP	Quality Assurance Project Plan
RA	Remedial Action (Remedial Action shall mean all activities Settling Defendants are required to perform under the 2016 CD to implement the 2011 ROD, in accordance with the SOW, the final approved RD submission, the approved RA Work Plan and other plans approved by EPA, including the ICIAP, until the Performance Standards are met, and excluding performance of the RD, O&M, and the activities required under the Retention of Records section of the 2016 CD.)
RAOs	Remedial Action Objectives
RAWP	Remedial Action Work Plan

DRAFT

LIST OF ACRONYMS/ABBREVIATIONS/COMMON TERMS (continued)

RD	Remedial Design (Remedial Design means those activities to be undertaken by Settling Work Defendants to develop the final plans and specifications for the Remedial Action pursuant to the Remedial Design Work Plan.)
RDWA	Remedial Design Work Area. (The RDWA consists of the NE/CE Area and includes potential treated water end use locations that may be adjacent to or outside of OU2.)
RDWP	Remedial Design Work Plan
RO	Reverse osmosis
RWQCB-LA	Regional Water Quality Control Board, Los Angeles Region
Site	Omega Chemical Corporation Superfund Site, originally listed on the National Priorities List on January 19, 1999, which is located in Los Angeles County, California, and includes the contamination being addressed by multiple Operable Units.
SOPs	Standard Operating Procedures
SOW	Statement of Work, Appendix B to the 2016 CD.
Supervising Contractor	The entity selected by SWDs to oversee field work.
SVOCs	Semivolatile organic compounds
SWDs	Settling Work Defendants, as identified in Appendix E to the 2016 CD. SWDs include the McKesson Corporation and OPOG (Omega Chemical Corporation Superfund Site Potentially Responsible Party Organized Group).
TDS	Total dissolved solids
UGSG	United States Geological Survey
VOCs	Volatile organic compounds
WAMP	Work Area Monitoring Plan
Waste Material	Shall mean (1) any “hazardous substance” under Section 101(14) of CERCLA, 42 U.S.C. § 9601(14); (2) any pollutant or contaminant under Section 101(33), 42 U.S.C. § 9601(33); (3) any “solid waste” under Section 1004(27) of RCRA, 42 U.S.C. § 6903(27); or as any of the foregoing terms are defined under any appropriate or applicable provisions of California law.

DRAFT

LIST OF ACRONYMS/ABBREVIATIONS/COMMON TERMS (continued)

WDR	Waste Discharge Requirements
Work	All activities and obligations the SWDs are required to perform under the 2016 CD, except the activities required under the Retention of Records section of the 2016 CD.
Work Area	The portions of OU2 that are the subject of Work under the 2016 CD and the SOW.
WRD	Water Replenishment District of Southern California

LIST OF ADDITIONAL ACRONYMS AND ABBREVIATIONS

1,1-DCA	1,1-Dichloroethane
1,1-DCE	1,1-Dichloroethene
1,1,2-TCA	1,1,2-Trichloroethane
1,2-DCA	1,2-Dichloroethane
1,2,3-TCP	1,2,3-Trichloropropane
cis-1,2-DCE	cis-1,2-Dichloroethane
Freon 11	Trichlorofluoromethane
Freon 113	1,1,2-Trichloro-1,2,2-trifluorethane
NDMA	N-Nitrosodimethylamine
PCE	Tetrachloroethene, perchloroethene
TCE	Trichloroethene

PRE-DESIGN INVESTIGATION WORK PLAN
NORTHERN EXTRACTION AND CENTRAL EXTRACTION AREAS
OPERABLE UNIT 2

OMEGA CHEMICAL CORPORATION SUPERFUND SITE
LOS ANGELES COUNTY, CALIFORNIA

1. INTRODUCTION

This Pre-Design Investigation (PDI) Work Plan (PDIWP) has been prepared by Hargis + Associates, Inc. (H+A) on behalf of the Settling Work Defendants (SWDs) to document the work scope for the PDI to support Remedial Design (RD) of the Northern Extraction/Central Extraction (NE/CE) Area for the Omega Chemical Corporation Superfund Site (Site) (Figures 1 and 2). This PDIWP is being submitted concurrently with the RD Work Plan (RDWP).

The Work covered by the Statement of Work (SOW), Appendix B to the Operable Unit 2 (OU2) Consent Decree (2016 CD) includes groundwater containment in the NE/CE Area. The Remedial Design Work Area (RDWA) is a portion of OU2. It includes the NE/CE Area plus any potential locations outside this area that could be used for water end use management (Figure 2).

1.1 Objectives

The overall objective of the PDI is to fill critical data gaps that have been identified to support RD. This PDIWP provides the analysis of data gaps based on an evaluation of existing data and presents a field investigation plan to obtain the identified data. The PDIWP has been prepared to fulfill the requirements in Section 3.3 (a) of the SOW, Appendix B of the 2016 CD for OU2 at the Site (United States Environmental Protection Agency [EPA], 2016a). The following table provides the section in this PDWIP that fulfills each requirement in SOW Section 3.3 (a).

Requirements in SOW Section 3.3a	PDIWP Section
(1) An evaluation and summary of existing data and description of sampling and analysis activities needed to address NE/CE Area RD	Appendix A: Data Gaps Analysis Appendix B: Data Quality Objectives (DQOs) Appendix C: Field Sampling Plan (FSP)
(2) Plans for the installation of groundwater monitor wells, the measurement of water levels from new and existing wells, the collection and periodic analysis of samples from new and existing groundwater wells, and aquifer testing in the NE/CE Area capture zone	Section 4.1 - 4.6: Scope of PDI Appendix C: FSP
(3) Preparation and submittal of a FSP and Quality Assurance Project Plan (QAPP)	Appendix C: FSP Appendix D: QAPP
(4) Provisions for the preparation of a PDI Evaluation Report	Section 4.7 Scope of PDI

The data gaps analysis presented in Appendix A focuses on the following broad design considerations:

- extraction wellfield (depth and area requiring containment; quantity and quality of extracted water);
- treatment system (capacity and treatment requirements for each end use); and
- treated groundwater end use (capacity requirements) with the expectation that capacity information for basin recharge and reclamation end uses would be obtained from the owners/operators of nearby spreading basins and reclaimed water distribution systems as well as permitting Agencies including the Regional Water Quality Control Board, Los Angeles Region (RWQCB-LA) and Los Angeles County Department of Public Works, as detailed in the RDWP.

The PDI field investigation work is intended to provide data to support the RD of the CE/NE Area Remedial Action (RA). DQOs are presented in Appendix B and have been incorporated into the QAPP (Appendix D) for the investigations being conducted to fulfill the requirements of the 2016 CD SOW.

1.2 Description of Remedial Action in the NE/CE Area

The scope of the NE/CE Area RA is outlined in the 2016 CD (EPA, 2016a). It includes the design, construction, and operation of one or more groundwater extraction and treatment systems to satisfy and maintain the NE/CE Area Performance Standards (defined in subparagraph 1.3c of the SOW). The NE/CE Area covered by the SOW is a portion of OU2 presented in the OU2 Interim Action Record of Decision, dated September 20, 2011 (2011 ROD). It is bounded by the OU2 boundary depicted in Attachment C of the 2016 CD. It includes the NE Area, the CE Area, and the northern portion (in the vicinity of Telegraph Road) of the Leading Edge (LE) Area as depicted in the 2011 ROD. These three areas are jointly referred to as the NE/CE Area in the SOW. Figure 2 shows the OU2 boundary, the NE/CE Area, and the general area of the RDWA. The RDWA includes the NE/CE Area as well as areas outside the NE/CE Area to the extent that such additional locations may be utilized to implement the treated groundwater end use.

The main components of the NE/CE Area Work are extraction wellfields in the NE Area (in the vicinity of Sorensen Avenue) and the CE Area (in the vicinity of Telegraph Road); one or more treatment systems that will be determined by selected water end use; an end use of treated groundwater including one or more of the following: reinjection (shallow and/or deep), basin recharge, and reclamation; associated conveyance pipelines; and Institutional Controls (ICs).

1.2.1 Remedial Design Work Area

The RDWA consists of the NE/CE Area and includes potential treated water end use areas that may be adjacent to or outside of the NE/CE Area or OU2 (Figure 2).

1.2.2 Extraction Wellfields

The NE/CE Area will include two extraction wellfields, one in the NE Area and the other in the CE Area. Extraction in the CE Area will be in the vicinity of Telegraph Road; extraction in the NE Area will be in the vicinity of Sorensen Ave (Figure 2). Extraction wells in the NE/CE Area will perform in conjunction with one another to meet Performance Standards and variability in extraction rates between the two sets of extraction wells that may be necessary to achieve capture in the target zones.

In order to achieve the extraction wellfield objectives to hydraulically contain Contaminants of Concern (COCs) exceeding Maximum Contaminant Levels (MCLs) or Notification Levels (NLs) within the NE/CE Area and to intercept a significant amount of the higher concentration COC mass in the NE Area moving past Slauson Avenue, the current best estimate of the

required pumping rate for the NE/CE Area is 1,100 gallons per minute (gpm) (total). The NE Area pumping rate would be no less than 300 gpm, unless EPA approves a lower rate. Final groundwater extraction locations will be selected during the RD based on the results of PDI tasks.

1.2.3 Treatment System(s)

Pipelines will convey untreated groundwater from the extraction wellfields to the NE/CE Area groundwater treatment system(s). The major treatment processes required will be influenced to some degree by the end use(s) of treated groundwater. An advanced oxidation process (AOP) and liquid phase granular activated carbon adsorption will likely be used for all end uses of treated groundwater. AOP is used primarily for the treatment of 1,4-dioxane, but does provide some reduction of COC volatile organic compounds (VOCs) as well. Liquid phase granular activated carbon adsorption is used to treat COC VOCs and residual AOP amendments (peroxide). The treatment technology for hexavalent chromium may be ion exchange (IX) for the shallow reinjection end use. A membrane filtration process (reverse osmosis/nanofiltration [RO/NF]) might be used with or without IX for spreading basin, reclaim and/or deep reinjection end uses.

1.2.4 Treated Water End Use

In addition to groundwater extraction and treatment, the NE/CE Area Work requires the construction of water conveyance systems to transport treated groundwater from the treatment system(s) to the end use location(s). EPA has prepared an Explanation of Significant Differences (ESD) for OU2 (EPA, 2016b), which adds several end uses of treated groundwater and removes the preference for drinking water end use. Reinjection (shallow and/or deep), basin recharge, and reclamation will be evaluated during RD as potential end uses of the treated groundwater unless the SWDs and EPA mutually agree that it is no longer appropriate to evaluate one of the contemplated end uses after considering the cost-effectiveness and implementability of the end use.

1.2.5 Institutional Controls

The ICs are essentially informational ICs to reduce the possibility that production wells in the vicinity of OU2 could become contaminated and to prevent operation of the wells from interfering with the containment goals of the NE/CE Area RA. They include:

- (1) Annual notifications to all water rights holders in the Central Basin and other stakeholders as appropriate to explain the goals of the remedy, the status of the

remedy's implementation, the nature and extent of OU2 contamination and the most recently available groundwater data, and to discuss any related State or local restrictions and prohibitions on well-drilling and groundwater use without necessary approvals or permits;

- (2) Periodic meetings with EPA, State and local agencies with jurisdiction over well drilling and groundwater use within the Central Basin to exchange information on the planned or current operation of production wells within OU2 or its vicinity;
- (3) An annual review of available documentation maintained by the State and local entities to determine if water supply wells have been installed or other water rights holder had increased groundwater production or production capacity within OU2 or its vicinity; and,
- (4) Provisions, to the extent feasible, for contemporaneous notifications from State and local agencies with jurisdiction over well drilling and groundwater use within the Central Basin.

2. SITE BACKGROUND

This section provides an overview of background information pertaining to the work to be conducted as part of the PDI.

2.1 History

The RDWA is a portion of OU2. It includes the NE/CE Area plus any potential locations outside this area that could be used for water end use management. The majority of the OU2 area was irrigated agricultural land in the early 1900s and agricultural use persisted in this area through the 1950s (CH2M Hill, 2010). Beginning in 1907, oil and gas wells were installed as part of the Santa Fe Springs Oil Field and reached peak production by 1928. Commercial, industrial, and residential development started in the 1920s and 1930s. The historical industrial facilities included chemical manufacturing, processing, and distribution facilities; an oil refinery; oil production facilities, including oil and gas wells, storage facilities, and pipelines; machine shops; plating shops; dry cleaners; manufacturing facilities; gas stations, auto repair, and truck servicing; aircraft parts and engines; laboratories; commercial printing; heat treating; and a wide variety of other businesses. Rail lines and rail loading/ unloading locations are present throughout OU2 along with a large rail yard in the NE/CE Area. The NE/CE Area remains largely commercial and industrial today and continues to be home to a wide variety of businesses including businesses that currently use, or historically used, both chlorinated and non-chlorinated VOCs and chromium.

Residential use within the NE/CE Area is limited although there is residential use adjacent to the NE/CE Area. Residential areas are present in the southern portion of OU2 (the Leading Edge Area south of Lakeland Road and west of Balsam Street), north of Washington Boulevard near its intersection with Crowndale Avenue, and west of the intersection of Lambert Road and Santa Fe Springs Road. Zones with residential buildings also surround OU2 on the southeast, northwest, and west (Figure 3). A recent area of industrial property converted to residential use is the Golden Springs Redevelopment Project (i.e., Villages at Heritage Springs), located immediately south of Telegraph Road between Bloomfield Avenue and Norwalk Boulevard. This property received redevelopment approval from California Department of Toxic Substances Control (DTSC) after undertaking soil removal actions and appropriate risk assessment for residential use.

The central portion of the Santa Fe Springs Oil Field overlaps OU2 and the RDWA (Figure 4). The California Department of Conservation, Division of Oil and Gas lists a total of 1,378 wells in the Santa Fe Springs Oil Field. Some of these wells are active, but a majority of them were abandoned. It is possible that oil production wells abandoned prior to about 1965 were not

completely sealed (i.e., they were likely pressure grouted in the production interval, but not all the way to the ground surface) and their corroded and collapsed steel casings could provide conduits for downward groundwater flow and contaminant migration.

2.2 Regulatory History Summary

The EPA assessment of the extent of groundwater contamination at OU2, consisted of several rounds of investigation beginning in 2002 and included the use of temporary hydropunch locations and a permanent network of groundwater monitoring wells developed over several years.. The following is a summary of environmental regulatory and enforcement action for OU2:

- 2010 – EPA completed and published the Remedial Investigation (RI) and Feasibility Study (FS) for OU2 groundwater which included groundwater assessment activities that helped characterize contaminated groundwater within OU2 (CH2M Hill, 2010).
- 2010 – EPA issued the Proposed Plan Fact sheet.
- 2011 – EPA issued an Interim Action Record of Decision (ROD) for OU2 groundwater (EPA, 2011). The Interim Action consisted of groundwater extraction and treatment with drinking water being the preferred end use of treated groundwater. Injection was considered as a backup end use if EPA determined, based on Potentially Responsible Parties (PRPs) efforts to negotiate agreements with drinking water purveyors, that a drinking water end use could not be implemented in a timely manner.
- April, 2016 – EPA signed a CD with SWDs requiring SWDs to implement the majority of the 2011 ROD for OU2, including design, construct, and operate an interim groundwater treatment system(s) and conduct additional investigations for OU2 groundwater. The 2016 CD is currently awaiting approval by the Federal District Court (EPA, 2016A).
- May 2016 – EPA issued an ESD to update the 2011 ROD. The primary change to the 2011 ROD included removing the preference for a drinking water end-use and expanding the end-use options to include additional end use options:
 - Delivery to an existing reclaimed water system (for irrigation and/or industrial use);
 - Return to groundwater basin using shallow or deep reinjection wells;
 - Return to groundwater basin using an existing spreading basin; or,
 - A combination of end uses.

2.3 Site Investigations

There are a large number of known or potential source areas within OU2 and the RDWA. A subset of the known sources that have contributed to the OU2 groundwater contamination are currently under State oversight (DTSC or RWQCB-LA) and are currently being addressed by State led actions. However, a large number of the potential source properties have not yet been adequately evaluated. Adequate evaluation along with source control remedial actions as appropriate are necessary to ensure that the NE/CE Area remedy will be maximally effective. In the 2011 ROD, EPA noted that the State will require source control actions at these facilities as needed and expects that, if and when additional source areas are identified, they will be addressed by the combined efforts of the State and EPA (EPA, 2011). Investigation of known and potential OU2 source areas continues.

2.4 Geology and Hydrogeology

OU2 is located in the Whittier area of the Central Basin, a sub-basin of the coastal plain of Los Angeles County (CH2MHill, 2010). The coastal plain is bounded on the west and south by the Pacific Ocean and by mountains on the north, east, and southeast. The coastal plain is underlain by an extensive groundwater basin in Los Angeles and Orange Counties.

Water-bearing sediments identified in the Whittier area extend to an approximate depth of at least 1,000 feet below ground surface (CH2M Hill, 2010). The identified geologic units consist of recent alluvium, the upper Pleistocene Lakewood Formation, and the lower Pleistocene San Pedro Formation. The Pliocene and Miocene marine sediments below the San Pedro Formation generally contain saline water in the Whittier area, are considered nonwater-bearing where exposed in the Puente Hills, and are not addressed in this report. Figure 5 shows a generalized stratigraphic column of fresh water- bearing sediments in the coastal plain of Los Angeles.

The major geologic structures in the area include the northwest-trending La Habra syncline underlying the alluvial basin (in the general vicinity of Slauson Avenue) and the west-northwest trending Santa Fe Springs (also named Coyote) anticline in the general area between Los Nietos Road and Telegraph Road (Figure 6) (CH2M Hill, 2010).

There are no known faults within OU2. The Whittier and Norwalk faults are both west-northwest trending, with the Whittier fault being located to the northeast of OU2 in the Puente Hills and the Norwalk fault being located to the south of OU2 (approximately along Interstate 5).

There are at least three different interpretations relating to hydrostratigraphic units in the vicinity of OU2 as follows: the California Department of Water Resources (CDWR) Bulletin 104 (CDWR, 1961); the 2010 RI Report (2010); and the USGS (2014 and on-going). Bulletin 104 focuses on identifying aquifers within the Los Angeles Basin. The 2010 RI Report builds upon Bulletin 104 and focuses on stratigraphic units that consist of a combination of coarse- and fine-grained sequences within and in the vicinity of OU2. The USGS focus is on chronostratigraphic units in the Central Basin which includes age correlated units that are not necessarily tied to aquifer/aquitard sequences. All three of the interpretations incorporate some of the key geologic structural features in the vicinity of OU2, but have conflicts in overall interpretation. A generalized description of the hydrostratigraphy based on Bulletin 104 nomenclature as adopted from the 2010 RI Report is presented in this Section. A comparison of existing water quality data using the Bulletin 104 and the 2010 RI Report is presented in the data gaps analysis (Appendix A).

The shallowest hydrostratigraphic units (recent alluvium) include the semiperched aquifer, the Gaspur aquifer, and the Bellflower aquiclude (Bellflower aquitard). The Gaspur aquifer is mainly sand and gravel with a small amount of interbedded clay. The Gaspur aquifer is only found within the recent alluvium. However, the CDWR considers the semiperched aquifer and the Bellflower aquiclude to be present in both the recent alluvium and the upper part of the Lakewood Formation. The saturated portion of the Gaspur aquifer is for the most part to the west of OU2, but does extend east into OU2 in the area roughly centered about Slauson Avenue. The Gaspur aquifer may be present in the vicinity of the NE Area, although may not be present along the southeastern portion of this area. The Gaspur aquifer may be present on the western most portion of the CE Area; however, the current water table appears to be beneath the bottom of the Gaspur aquifer in this area.

The Lakewood Formation consists of non-marine deposits including the Artesia and Gage aquifers although the Artesia aquifer may only be present to the south of the RDWA and therefore is not considered relevant to the RDWA. The Gage aquifer may be absent or unsaturated in areas of OU2 north of the CE Area, and is generally present and saturated within OU2 from near the CE Area to the south. The Gage aquifer does not appear to be an important source of drinking water in the Whittier area, based on elevated total dissolved solids (TDS) concentrations measured in groundwater samples collected at OU2.

The San Pedro Formation unconformably underlies the Lakewood Formation. The San Pedro Formation has been subdivided into five named aquifers separated by clay layers. A fine-grained layer is also typically present at the top of the sequence; although, in localized areas, the uppermost San Pedro Formation aquifer may be merged with the overlying aquifer,

and one or more of the five aquifers may also be merged (CDWR, 1961). The five aquifers defined within the San Pedro Formation include, from top to bottom, the Hollydale, Jefferson, Lynwood, Silverado, and Sunnyside aquifers. The Hollydale aquifer has been identified by the CDWR (1961) throughout most of OU2 with the exception of the northern most portion and the southeastern tip. As such, the Hollydale aquifer is expected to be saturated and present in the NE and CE areas. The other aquifers within the San Pedro Formation are thought to be present over most or all of OU2; however, the PDI scope of investigation is generally limited to the Hollydale and Jefferson aquifers with some limited investigation in the Lynwood aquifer in the NE Area based on data gaps analysis which is presented in Appendix A.

The depth to groundwater at and in the vicinity of the RDWA has fluctuated over time. Water level hydrographs have been prepared for wells monitored by the Los Angeles County Department of Public Works between 1947 and 2016 (Figure 7). The water levels were highest at the start of the monitoring period (1947) and declined relatively steadily until the late 1950's, at which point the water levels were at a historical low. Following this time, which is roughly about the time the Central Basin was adjudicated, water levels recovered to some degree. Between 1970 and 2016, the water levels have fluctuated seasonally on the order of 5 to 20 feet. During this same time frame, the overall water level fluctuation has been almost 60 feet, with the high water level for the period of monitoring occurring in the mid-1990s and the low water levels occurring in 1978 and over the past several years. The direction of groundwater flow has been evaluated by EPA in the 2010 RI and subsequent groundwater monitoring reports. Overall, the general direction of groundwater flow has been south-southwesterly flow in the area north of the CE Area and to the south-southeast in the area south of the CE Area. There have been shifts in the direction of groundwater flow that appear to correlate with changes in groundwater elevations.

Vertical hydraulic gradients have been evaluated as part of the 2010 RI and subsequent groundwater monitoring reports based on water levels measured in cluster monitor wells (monitor wells with screened intervals completed at different depths at the same general location). At cluster wells, water levels measured in deeper screens are generally lower than water levels in shallower screens.

2.5 Groundwater Chemistry

Routine groundwater sampling monitor wells has been conducted by various parties in and adjacent to the RDWA. Groundwater monitoring in OU2 has focused on constituents that have been detected at concentrations exceeding their screening levels (MCLs and NLs) and have been grouped in five categories: VOCs, semi-volatile organic compounds (SVOCs), emergent compounds, metals, and general chemistry.

There were multiple VOCs that exceeded screening levels. The sources of the VOCs appear to be related to multiple sites within and adjacent to OU2. The 2010 RI Report identified VOCs that exceeded screening levels and the 2011 ROD identified eleven VOCs that are part of the Main COCs for OU2.

There was only one SVOC that was reported above the screening level (bis (2 Ethylhexyl) phthalate). It is suspected that the detections are due to sampling activities and are not representative of groundwater conditions in OU2 (CH2M Hill, 2010). However, since bis(2-Ethylhexyl)phthalate was detected above its screening level, this analyte was considered a chemical of potential concern (COPC) for OU2 in the 2010 RI Report. The 2011 ROD included bis(2 Ethylhexyl)phthalate in the lists of treatment standards for treated groundwater end use, but did not include it as a Main COC.

Emergent compounds (1,4-dioxane, 1,2,3-trichloropropane [1,2,3-TCP], N Nitrosodimethylamine [NDMA], perchlorate, and hexavalent chromium) were detected at concentrations exceeding their respective screening levels. Therefore, each of these emergent compounds was considered a COPC for OU2 in the 2010 RI Report. The compounds 1,4-dioxane, 1,2,3-TCP, perchlorate, hexavalent chromium and NDMA were suspected to be related to one or more operations within OU2. The 2011 ROD included 1,4 dioxane and hexavalent chromium in the list of Main COCs, but did not list the remaining emergent compounds.

Aluminum, antimony, arsenic, total chromium, manganese, mercury, nickel, selenium, thallium, and vanadium were detected at concentrations exceeding their respective screening levels, and were therefore considered COPCs for OU2 in the 2010 RI Report. Some of detected metals could be naturally occurring but industrial sources located within OU2 may have also contributed to these metals exceedances given that various industrial sources used these compounds (including total chromium and arsenic). The 2011 ROD did not include any of the metals as Main COCs, but did include aluminum, manganese, total chromium and selenium in one or both lists of treatment standards for treated groundwater end use.

General chemistry parameters have also been assessed in OU2 and several general chemistry parameters have been detected in exceedance of screening levels (e.g. TDS, nitrate and sulfate). The majority of general chemistry detections represent background (or natural) conditions in groundwater. The ROD did not include any of the general chemistry constituents as Main COCs, but did include TDS, nitrate and sulfate in the lists of treatment standards for treated groundwater end use.

2.5.1 Constituents

The 2011 ROD identified 13 COCs for OU2, eleven of which are VOCs (tetrachloroethene [PCE], trichloroethene [TCE], Trichlorofluoromethane [Freon 11], 1,1,2-trichloro-1,2,2-trifluoroethane [Freon 113], 1,1-dichloroethene [1,1-DCE], cis-1,2-dichloroethene [cis-1,2-DCE], chloroform, carbon tetrachloride, 1,1-dichloroethane [1,1-DCA], 1,2-dichloroethane [1,2-DCA], and 1,1,2-trichloroethane [1,1,2 TCA]); one is an inorganic constituent (hexavalent chromium) and the remaining compound is 1,4-dioxane (Table 1). These 13 COCs will be referred to as Main COCs in the RD documents and are included in the COCs for the purpose of the RD. Containment of the Main COCs should also contain other chemicals, including benzene, toluene and other fuel related compounds, identified in the 2010 RI as chemicals exceeding screening levels.

The 2011 ROD also identified treatment standards for different end uses, which included ten of the 13 Main COCs and an additional eight or nine constituents, depending on end use. For the purposes of the PDI, the additional constituents will be referred to as “Key Treatment Constituents” (Table 1). The Key Treatment Constituents are considered during the RD based on end use, but are not included in the COC list. Based on the end use selected, extracted water will be treated for chemicals and constituents exceeding permit limits.

2.5.2 Distribution

The distribution of Main COCs and Key Treatment Constituents within and in the vicinity of the RDWA was evaluated as part of the data gaps analysis (Appendix A). The following provides a summary of the current understanding of the general distribution of Main COCs in the RDWA. The distribution of COCs will be refined during the PDI to define the target zone for the NE and CE extraction wellfields.

- Of the Main COC VOCs, PCE and TCE exceeded their respective MCLs over the largest area and greatest depth within the RDWA. Both of these compounds are common solvents used/handled by many sites within the RDWA and OU2. The concentrations of these two compounds are generally greatest in the vicinity of source sites in shallow groundwater and have not been detected exceeding MCLs in monitor wells deeper than 200 feet within the RDWA. In addition, the concentration of these two compounds generally decreases toward the southern end of the CE Area; although there has been detection of relatively elevated concentrations of these compounds to the south of the RDWA, indicating the presence of source areas in the LE to the south of the CE Area.

- Freon 11 and Freon 113 were detected at lower concentrations and within the overall extent of areas of PCE and TCE detections. Freon 11 and Freon 113 were known to be used by businesses in OU2 and the types of businesses known to operate currently and historically in OU2 were the types of businesses that frequently utilized Freons. Uses included dry cleaning, cold cleaning electrical parts, vapor phase cleaning, photographic film and magnetic tape cleaning, use in refrigerants, use in blowing agents, use in oil field activities, use in fire extinguishing, use in propellants, and use in oil field activities. Freon was also commonly found in both automotive and industrial waste oils. Freon 113 has been infrequently analyzed at sites within OU2, but it was commonly found in soil, soil gas, or groundwater at sites where it was analyzed. Freon 11 was more frequently analyzed and was found in at least one environmental medium at those properties where it was tested for.
- The remaining Main COC VOCs are generally within the overall extent of PCE and TCE.
- 1,4-Dioxane has been detected exceeding the NL over an area and depth similar to PCE and TCE, although at generally lower concentrations. This compound is often associated with the common solvent 1,1,1-trichloroethane, which has been used/handled by many sites within the RDWA. 1,4-Dioxane has not been analyzed in as many groundwater sample locations as VOCs; however, the concentration of 1,4-dioxane is generally greatest in the vicinity of source sites in shallow groundwater and has not been detected exceeding the NL in monitor wells deeper than 200 feet within the RDWA.
- Hexavalent chromium has been detected exceeding the MCL over a relatively wide area of the RDWA, although it does not appear to be as extensive as PCE and TCE or 1,4-dioxane. Hexavalent chromium has not been analyzed in as many groundwater sample locations as VOCs; however, the concentration of hexavalent chromium is generally greatest in the vicinity of source sites in shallow groundwater and has not been detected exceeding the MCL in monitor wells deeper than 200 feet within the RDWA. It should be noted that neither of the SWDs sites are sources of hexavalent chromium.
- Relative to the Bulletin 104 hydrostratigraphic units, the Jefferson aquifer is the deepest aquifer in which the historical average concentration at each sampling location of one or more of the Main COCs exceeded the respective drinking water MCL (or NL in the case of 1,4-dioxane) with two minor exceptions described as follows: The first exception was at EPA Monitor Well MW17C (Figure 9) where TCE slightly exceeded the drinking water MCL in the Lynwood aquifer. The second exception was at EPA

Monitor Well MW24D where 1,4-dioxane exceeded the NL in the Lynwood aquifer in one groundwater sample (the first), but was either not detected or at/below the NL in subsequent samples.

- Relative to 2010 RI hydrostratigraphic units, hydrostratigraphic Unit 6 is the deepest unit in which the historical average concentration at each sampling location of one or more Main COCs exceeded the respective drinking water MCL (or NL in the case of 1,4-dioxane).

3. DATA NEEDS AND USES

The objectives for the PDI work are to provide data to support RD of the NE/CE Area wellfield and treatment systems, as well as providing data to support evaluation and remedy design for the end use of treated groundwater.

In order to identify the data gaps to support the NE/CE Area RD, the SOW (Section 3.3[a][1]) stipulates that the PDIWP must include an evaluation and summary of existing data relevant to the first three items below, and provide a description of sampling activities needed to:

- Define the areas and depths targeted for hydraulic control in the NE and CE Areas;
- Estimate hydraulic conductivity in the NE/CE Area capture zone;
- Select groundwater extraction rates and locations for design of the remedy; and
- Address any concerns about the quantity, quality, completeness, or usability of water quality or other data upon which the design will be based.

Data gaps were identified in the Data Gaps Analysis, attached to this document as Appendix A. The evaluation of existing data and identification of critical data gaps focused on the following broad design considerations:

- extraction wellfield (depth and area requiring containment);
- quantity and quality of extracted water;
- treatment system (capacity and treatment requirements for each end use); and
- treated groundwater end use design.

Data needs were identified and developed by addressing specific problem statements and project objectives through the DQO process, attached to this document as Appendix B. The SWDs have developed an optimized plan to collect and analyze PDI data in a time efficient manner. The plan incorporates concurrent implementation of selected tasks and also incorporates sequential data collection to minimize wasted or inefficient data collection efforts. There were six field tasks identified as part of the DQO process as follows (Figure 8):

- Task 1: Access and Early Water Level Monitoring
- Task 2: Install and Sample NE/CE Exploratory Boreholes and Deep Monitor Wells
- Task 3: Install and Sample NE/CE Monitor Wells
- Task 4: Access / Install and Sample Monitor Wells in Primary ReInjection Area

DRAFT

- Task 5: Hydraulic Testing
- Task 6: PDI Groundwater Monitoring

The field data collected as part of the above tasks will address the data needs identified to fulfill the requirements outlined in the SOW for the PDIWP (Table 2).

4. SCOPE OF PRE-DESIGN INVESTIGATION

The scope of the PDI includes field activities (recommended by the Data Gap Analysis and the DQO process) and preparation of the PDI Evaluation Report. The PDI activities have been organized in seven tasks: Tasks 1 through 6 are field tasks, as described in the DQOs and summarized in this section, and Task 7 is for preparation of the PDI Evaluation Report (Figure 8).

Specific methods and procedures for the field activities are established in the FSP (Appendix C) and in the Standard Operating Procedures (SOPs) attached to the FSP (Attachments C-1 and C-2). Detailed Quality Assurance/Quality Control procedures, particularly with respect to sample collection and analysis, are provided in the QAPP (Appendix D). A brief outline of each task is provided below. Additional details are provided in the FSP.

4.1 Task 1: Access and Early Water Level Monitoring

Task 1 consists of obtaining access for PDI monitor wells in the NE/CE Area and conducting early water level monitoring at 28 existing monitor wells, located throughout the RDWA. The objective of the early water level monitoring is to use the trends in water level elevations within and between hydrostratigraphic units to refine the understanding of the nature and distribution of hydrostratigraphic units within the RDWA. This information will support PDI monitor well installation, particularly during Task 3.

4.1.1 Access

Installation of monitor wells and ancillary structures as part of the PDI will require obtaining long-term access to work areas, securing any required permits from municipal government agencies, and assuring that PDI installations do not impinge upon existing utility lines or interfere with current land use.

Where possible, PDI monitor wells and other structures will be placed in public rights-of-way. The objective is to simplify access by minimizing the number of landowners that would need to approve well placement, and by minimizing the types of access agreements required. If necessary, private property owners will be contacted, and any access agreement requested by the property owner would be prepared by SWDs' representatives.

Application for any required permits for monitor well installation will be submitted in advance of field activities. It is anticipated that permit requirements will include encroachment and

excavation permits issued by the relevant city and/or county public works agency, traffic control permits as needed, and monitor well construction permits issued by the Los Angeles County Department of Public Health, Environmental Health Drinking Water Program.

4.1.2 Early Water Level Monitoring

Pressure transducers will be installed at 28 existing EPA/Water Replenishment District of Southern California (WRD) monitor wells at 11 cluster locations. EPA/WDR monitor well identifiers and locations are provided (Table 3; Figure 9). Water levels will be monitored on a nearly continuous basis using pressure transducers with built-in data recorders. The pressure transducers allow for a robust analysis of water level trends in monitor wells over relatively short time frames, weeks to months. The data will be downloaded quarterly and compared to periodic manual water level measurements.

4.2 Task 2: Exploratory Borings and Deep Monitor Wells in NE/CE Area

Task 2 consists of drilling exploratory boreholes in the NE/CE Area; installation of the deepest monitor wells in the NE/CE Area; and initial and confirmation sampling at each monitor well. The objectives of Task 2 are to assess hydrostratigraphic conditions, support selection of screened intervals of remaining PDI monitor wells in the NE/CE Area; and with data collected during Task 3 provide COC water quality data to define the areas and depths targeted for hydraulic control in the vicinity of the NE and CE Areas.

4.2.1 Install Exploratory Borings and Deep Monitor Wells

At each of the seven locations where PDI monitor well clusters are recommended in the NE/CE Area, an exploratory boring will be drilled first using mud rotary drilling methods. Locations, identifiers, and target depths for proposed exploratory borings have been provided (Table 4; Figure 9). The total depth of each exploratory borehole extends to the deeper of the following two hydrostratigraphic units: the bottom of EPA's hydrostratigraphic Unit 6 or the bottom of the Lynwood aquifer, as described in Bulletin 104 (CDWR, 1961). The exploratory borehole will also be geophysically logged to characterize subsurface lithology.

The lithologic and geophysical logs from the exploratory borings will be reviewed along with available water levels obtained using pressure transducers in Task 1, and the exploratory borehole will be converted into a monitor well screened in the deepest aquifer targeted for that well cluster. The deepest monitor well conceptually targets the Jefferson or Lynwood aquifers, depending on well location (Table 4). These monitor wells will be given the following identifiers: NE-1 MWD, NE-2 MWD, NE-3 MWC, CE-1 MWC, CE-2 MWC, CE-3 MWC,

and CE-5 MWC. The bottom of the exploratory borehole will be properly sealed from the total depth to near the bottom of the deepest monitor well.

The monitor well at each location will be developed using appropriate bailing, surging and/or pumping methods.

4.2.2 Initial and Confirmation Sampling

Within 2 to 4 weeks of well development, an initial groundwater sample will be collected for COC analysis (Tables 5 and 6), and a pressure transducer will be relocated from one of the Task 1 monitor wells to the newly installed PDI monitor well (Table 3). A confirmation sample will be collected from the respective monitor well approximately 6 weeks after the initial groundwater sample. The confirmation sample will be analyzed for COCs, Key Treatment Constituents, treatment system constituents, general chemistry, and emergent compounds (this sample grouping will be referred to as the “moderate list”) (Tables 5 and 6). After the initial and confirmation samples have been collected, the COC results will be evaluated to determine if deeper monitor well(s) at one or more of the NE/CE Area cluster well locations will need to be installed.

4.3 Task 3: NE/CE Area Monitor Wells

Task 3 consists of installation of 17 PDI monitor wells at eight locations in the NE/CE Area and initial and confirmation sampling of each monitor well.

The primary objective of Task 3 is to provide COC data (to be used in conjunction with data obtained from Task 2) for the determination of the target zone for the groundwater extraction wellfields in the NE/CE Area. The target zone will be determined by the project team in consultation with EPA. Analytical data obtained from Task 3 will also be used to characterize influent water quality to the groundwater treatment system.

4.3.1 Install Monitor Wells

Seventeen PDI monitor wells will be installed at eight locations in the NE/CE Area and the anticipated length and depth of screened intervals for each monitor well has been provided (Table 5; Figure 9). The project team in consultation with EPA will select the actual screen intervals based on: evaluation of lithologic data from existing and newly installed PDI monitor wells and exploratory boreholes; water level elevations monitored using pressure transducers during Tasks 1 and 2; and recent water level and water quality data from nearby existing monitor wells (WAMP and PDI Task 6).

These monitor wells will be installed using hollow-stem auger or sonic drilling methods. Most of the monitor wells conceptually target saturated aquifers above the aquifer screened by the deep monitor well, installed as part of Task 1.

The newly installed monitor wells will be developed using appropriate bailing, surging and/or pumping methods.

4.3.2 Initial and Confirmation Sampling

Within 2 to 4 weeks of well development, an initial groundwater sample will be collected for COC analysis and a pressure transducer will be relocated from one of the Task 1 monitor wells to the newly installed PDI monitor well. A confirmation sample will be collected from the respective monitor well approximately 6 weeks after the initial groundwater sample. The confirmation sample will be analyzed for analytes in the moderate list (Tables 5 and 6).

4.4 Task 4: Primary ReInjection Area Monitor Wells

Task 4 consists of the installation and sampling of 4 shallow PDI monitor wells in the vicinity of a primary candidate reinjection area (at locations identified as INJ-1, INJ-2, INJ-3, and INJ-4) and a contingency plan for additional monitor well installation and sampling in the contingency candidate reinjection area if necessary (at locations identified as CINJ-1, CINJ-2, and CINJ-3) (Figure 9). If needed, deep reinjection might be evaluated if the results of the primary and contingency candidate shallow reinjection areas do not support reinjection end use and the SWDs do not eliminate reinjection as an end use. The approach to assessing the deep reinjection area(s) would be similar to the approach to evaluating shallow reinjection areas, but at greater depths within the RDWA. Should deeper reinjection evaluation be pursued, a new FSP would be prepared for EPA review and concurrence prior to conducting the deep reinjection area investigation.

The objectives of Task 4 are to determine if reinjection is viable in the respective area, and if so, define areas and depths of reinjection; and support evaluation of end use(s) of treated groundwater.

4.4.1 Access

Installation of PDI monitor wells in the primary candidate reinjection area and/or contingency candidate reinjection area will require obtaining long-term access to work areas, securing any required permits from municipal government agencies, and assuring that PDI installations do

not impinge upon existing utility lines or interfere with current land use, as described in Task 1. Access will be obtained for all monitor well locations in the respective candidate reinjection area prior to mobilizing for monitor well installation.

4.4.2 Install ReInjection Area Monitor Wells

Four primary candidate reinjection area shallow PDI monitor wells (or three PDI monitor wells for the contingency candidate reinjection area, if needed) will be installed using rotosonic drilling methods. The total depth of each monitor well extends slightly below the bottom of the first saturated aquifer at each location (Table 5).

The monitor wells at each location will be developed using appropriate bailing, surging and/or pumping methods.

4.4.3 Initial and Confirmation Sampling

Following well development, an initial groundwater sample will be collected for the moderate list of analytes and a confirmation groundwater sample will be collected for the moderate list and the WDR permitting constituents (referred to as the “long list”) (Tables 5 and 6). A pressure transducer will be relocated from one of the Task 1 monitor wells to the newly installed PDI monitor well. The initial groundwater samples will be collected approximately 1 month after the final monitor well is installed within the respective candidate reinjection area, and a confirmation sample will be collected approximately 6 weeks later.

4.4.4 ReInjection Evaluation

The project team in consultation with EPA, will evaluate lithologic, well development and water quality data after confirmation sample results have been received to determine whether to perform hydraulic testing (Task 5) in the respective (primary or contingency) candidate reinjection area. If testing is discontinued in the reinjection area, the SWDs will evaluate whether to continue reinjection evaluations at the contingency reinjection area(s) (Table 4; Figure 9). If evaluation is warranted at the contingency reinjection area(s), the steps outlined as part of Task 4 (PDI monitor well installation and sampling) will be conducted in the contingency candidate reinjection area.

4.5 Task 5: Hydraulic Testing

Task 5 includes hydraulic testing that will be performed to assess aquifer properties at the 24 newly installed PDI monitor wells in the NE/CE Area. Hydraulic testing will also be conducted in each of the PDI monitor wells installed in the candidate reinjection areas if the

water quality results and preliminary well yields determined during development suggest that the respective candidate reinjection area is potentially viable for injection of treated groundwater. Hydraulic testing in the candidate reinjection area would proceed in two phases: Phase 1 would consist of hydraulic testing conducted in a similar manner to the NE/CE Area and Phase 2 would consist of pilot injection testing.

The objectives for Task 5 are as follows: the aquifer test results for monitor wells within and adjacent to the target zone of the NE/CE Area extraction wellfield will be used to determine extraction rates required to meet capture zone performance standards for the NE/CE Area. The aquifer test results within the candidate reinjection areas would be used to evaluate viability of reinjection in the respective area.

4.5.1 NE/CE Area PDI Monitor Wells

The project team will review drawdown data from each NE/CE Area PDI monitor well collected during development (Tasks 2 and 3) to determine the appropriate extraction rate for a short-duration (anticipated to be 2 hours) constant rate discharge test. The pumping rate will be determined based on review of well development pumping data, as well as available data for nearby monitor wells screened within the same aquifer. The test pump will be appropriately sized, but will not exceed a capacity of 60 gpm.

The selection of observation wells and pumped wells will be reviewed by the project team. Observation wells have been tentatively identified for each monitor well hydraulic test in the FSP. The observation wells include nearby monitor wells to assess water level response due to pumping of the test well.

The hydraulic test will be initiated by extracting groundwater from the pumped well at a constant rate with manual and transducer water level monitoring in the pumped and observation wells.

The water level responses and extraction data will be processed and analyzed using appropriate analytical solutions to estimate hydraulic conductivity and transmissivity of the tested hydrostratigraphic unit at each test location.

4.5.2 Phase 1 Reinjection Area Monitor Wells

If water quality and well yields during development support testing of the PDI monitor wells installed in the candidate reinjection area, aquifer tests would be conducted at the respective PDI

monitor wells. The aquifer testing will be conducted in a similar manner to the aquifer testing of NE/CE Area monitor wells.

The results of hydraulic testing at the candidate reinjection monitor wells will be reviewed to determine if a pilot injection test is to be implemented. If the hydraulic tests results support continued evaluation, pilot injection testing (Phase 2) will be conducted.

If Phase 2 pilot injection testing is not conducted in the respective reinjection area, the SWDs will evaluate whether to continue reinjection evaluations at contingency reinjection area(s). If evaluations continue at contingency reinjection area(s), the steps outlined as part of Tasks 4 and 5 will be conducted in the contingency candidate reinjection area.

4.5.3 Phase 2 Pilot Injection Test

The project team will review hydraulic test data from the reinjection area monitor wells to select the one location for the pilot injection test and determine the injection rate. A pilot injection well will be installed within approximately 10 to 50 feet of the existing monitor well that exhibited the lowest transmissivity within the respective candidate reinjection area.

The pilot injection test will be initiated by injecting potable water from a nearby fire hydrant at a constant rate and obtaining manual and transducer water level data in the pilot injection well, adjacent monitor well, and other monitor wells within the reinjection area. Necessary permits, including obtaining a General WDR permit for injection, if needed, would be obtained prior to initiating pilot injection well construction and testing.

The water level responses and injection data will be processed and analyzed to assess relative efficiency of injection, and assess potential short-term injectability fatal flaws.

4.6 Task 6: PDI Groundwater Monitoring

Task 6 consists of monitoring water levels and water quality in selected existing EPA/WRD wells and new PDI monitor wells in the NE/CE Area and the candidate reinjection area.

The objectives of water level monitoring are to:

- Determine similarities/differences in water level elevations and trends in order to refine the understanding of hydrostratigraphic units near the NE/CE Area and within the RDWA;

- Determine direction of groundwater flow in different hydrostratigraphic units in the vicinity of the NE/CE Area to assist in locating extraction wells;
- Determine hydraulic gradients in the vicinity of the NE/CE Area to support development of estimated groundwater extraction rates; and
- Determine depth to groundwater and direction of groundwater flow in the vicinity of candidate reinjection areas.

The objectives of water quality monitoring are to:

- Define the areas and depths targeted for hydraulic control in the NE and CE Areas;
- Determine if reinjection is viable, and if so, define areas and depths of reinjection;
- Support evaluation of end use(s) of treated groundwater; and
- Design a treatment system.

4.6.1 Water Level Monitoring

Water levels can be measured on a periodic basis using water level sounders (manual measurements) or they can be monitored on a nearly continuous basis using pressure transducers with built in data recorders (automated measurements).

Periodic manual water level elevations will be measured at existing EPA and WRD monitor wells in the RDWA until the PDI field program is complete. Water levels at 28 of the EPA/WRD monitor wells will be monitored with transducers as part of Task 1, until the transducer is relocated, at which time periodic manual water level measurement of the respective well will be conducted as part of Task 6.

Pressure transducers will be installed in each of the new PDI monitor wells in the NE/CE Area and candidate injection area after they have been constructed and will then be monitored for the duration of the PDI. There are at least 28 monitor wells planned as part of the PDI.

The water level monitoring locations and frequency of water level monitoring at existing EPA/WRD monitor wells and new PDI monitor wells have been compiled (Table 3).

4.6.2 Water Quality Monitoring

Groundwater samples will be collected for laboratory analysis at the 28 PDI monitor wells and selected existing EPA and WRD monitor wells. Groundwater samples will be analyzed for

either COCs only; the moderate list, or the long list. The monitor wells scheduled for sampling, sample events, and analytes have been compiled (Tables 5 and 6).

4.6.2.1 Quarterly Monitoring

Quarterly PDI groundwater sample collection involves collection of groundwater samples for COC analysis from selected EPA/WRD monitor wells and newly installed PDI monitor wells. Initial and confirmation sampling are performed at PDI wells as part of Tasks 2, 3, and 4. The first quarterly sampling event will occur in the quarter following the completion of the confirmation sampling event at the first installed PDI monitor well (Task 3). The last PDI quarterly sampling event will be complete in the same quarter that the initial groundwater sample is collected from the last installed PDI monitor well.

4.6.2.2 Final Monitoring

The final contemporaneous comprehensive PDI groundwater sample event will be conducted in the quarter following the initial groundwater sample collection from the last PDI monitor well installed. The final sample event involves collection of groundwater samples for analysis of analytes from the moderate or long analyte list (Tables 5 and 6).

At the completion of the final PDI groundwater sample event, the water quality results will be reviewed with EPA to determine whether there is apparently anomalous data that would require additional sampling to resolve.

4.7 Task 7: PDI Evaluation Report

Task 7 consists of the preparation of the PDI Evaluation Report after completion of all field tasks (Tasks 1-6). In accordance with the SOW, Section 3.3(b), the report will include:

- A summary of the investigation performed;
- A summary of investigation results, including summary of validated data (i.e., tables and graphics), the results of data analyses, and a narrative interpretation of data and results;
- Data validation reports and laboratory data reports; and
- Conclusions and recommendations relative to the RD.

The PDI Evaluation Report will be submitted to EPA 60 Days after the final PDI groundwater sample is collected.

5. INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) will be generated during the PDI, including drill cuttings, drill fluids (water and bentonite mud), and water generated during well development, decontamination activities, well purging during sampling, and hydraulic testing. All IDW generated from PDI activities will be containerized, properly labeled, and temporarily stored at an appropriate location to be determined within the Work Area. Samples will be collected for waste profiling and sent to a California-certified laboratory for analysis in accordance with California Code of Regulations, Title 22, Section 66261.24. Following waste profiling, the IDW will be transported by a licensed waste hauler for disposal at an appropriately permitted solid or hazardous waste facility in accordance with Federal and State requirements. IDW will be stored for no more than 60 days during characterization and consolidation. Procedures for handling, characterization, and disposal of IDW are detailed in the FSP (Appendix C) and SOPs (Attachment C-1).

Based on the results of IDW sampling, an appropriate disposal method and destination will be determined.

6. PROJECT ORGANIZATION, ROLES AND RESPONSIBILITIES

The following sections cover the general areas of project management, project organization, and responsibilities of the project participants.

6.1 EPA Project Manager

The EPA Project Manager bears overall responsibility for the direction of the scope of work to be performed for the project. The EPA Project Manager will provide final review and approval of the PDIWP, the PDI FSP and supporting SOPs and supporting QAPP, reports generated upon conclusion of field work, and the PDI Evaluation Report. The EPA Project Manager will provide coordination of the overall project and will provide overview and direction to EPA's contractors.

6.2 EPA Project Quality Assurance Officer

The EPA Project QA Officer will review QA documents, including the QAPP which supports the PDIWP. The EPA Project QA Officer will provide comments and recommendations to the EPA Project Manager regarding appropriate methodologies, reporting limits, sampling, and preservation techniques, DQOs, and other chemistry-related issues. The EPA Project QA Officer will perform data validation tasks or will assign and supervise EPA data validation tasks as requested by the EPA Project Manager.

6.3 SWDs' Project Coordinator

The SWDs' Project Coordinator is the individual who represents the SWDs and is responsible for the overall coordination of the Work. In accordance with the 2016 CD, this SWD Project Coordinator must have sufficient technical expertise to conduct the Work and may not be an attorney representing any SWDs in this matter and may not act as the Supervising Contractor. SWDs' Project Coordinator may assign other representatives, including other contractors, to assist in coordinating the Work. It is anticipated that Jack Keener of de maximis, inc. will be the SWD's Project Coordinator.

6.4 Pre-Design Investigation Implementation Team

The PDI field tasks will be conducted by qualified contractors that will be responsible for implementation in accordance with this PDIWP and the FSP, as approved by EPA. The PDI Evaluation Report will be prepared by a qualified contractor that will be responsible for evaluating existing and PDI data to meet the requirements outlined in the SOW. The contractor

responsible for preparing the PDI Evaluation Report may rely on documents prepared by field implementation contractor(s) and/or other qualified contractors.

6.4.1 PDI Project Manager

The PDI Project Manager will be responsible for ensuring that each individual component of the PDIWP meets overall project objectives and will report to the SWDs' Project Coordinator. The PDI Project Manager must be experienced in environmental activities outlined in this PDIWP. Specific professional registrations are not required for the PDI Project Manager; however, if the PDI Project Manager serves as the Supervising Professional Geologist, the PDI Project Manager will be a Professional Geologist registered in California. The PDI Project Manager, to be assigned prior to scheduled activities, will:

- Assemble a project team who have the necessary experience/training requirements/certifications and technical skills to successfully execute the work conducted in this PDIWP;
- Ensure that the procedures specified in the FSP are implemented and that all field activities conducted in the RDWA meet stated objectives;
- Determine sampling and analytical strategies with the assistance of the QA team;
- Approve, designate, and monitor corrective action for all field and office activities, as needed; and
- Review and approve project documents, data assessment results, and database summary reports.

6.4.2 Additional Team Members

In addition to the PDI Project Manager, the PDI implementation team will consist of the following team members, with the roles and responsibilities described in the FSP (Appendix C):

- Project Quality Assurance (QA) Manager
- Data Manager
- Health and Safety Coordinator
- Field Task Managers
- Laboratory Project Manager

- Data Validation Project Manager

6.5 Pre-Design Tasks

The required pre-design tasks and deliverables related to the NE/CE Area Work are described in the SOW. The scopes of pre-design tasks are contained in supporting deliverables that are included with the following document that the SWDs will submit to EPA for approval.

- RDWP, which includes elements outlined in the SOW.

The RDWP will be prepared by CDM Smith, Inc. The supporting documents outlining the required pre-design tasks are:

Task	Document	Document Preparation
PDI	<ul style="list-style-type: none">• PDIWP, including<ul style="list-style-type: none">○ Data Gap Analysis○ FSP○ QAPP○ HASP• PDI Evaluation Report	<ul style="list-style-type: none">• H+A• H+A• H+A• Geosyntec• Geosyntec• Qualified Contractor
Groundwater Modeling	<ul style="list-style-type: none">• Groundwater Flow Modeling Work Plan• Groundwater Flow Model Development and Calibration Report• Groundwater Flow Model Predictive Simulations Report	<ul style="list-style-type: none">• Geosyntec• Qualified Contractor• Qualified Contractor
Groundwater Monitoring	<ul style="list-style-type: none">• Work Area Monitoring Plan	<ul style="list-style-type: none">• Geosyntec

DRAFT

7. HEALTH AND SAFETY

Health and safety during PDI field activities will be addressed by adhering to the provisions of the HASP prepared for the PDI (Appendix E).

8. DATA MANAGEMENT

The objective of data management is to establish procedures to be used during field investigations for documenting, tracking, and presenting investigative data. Data generated during the field investigations, as well as previously existing data, will form the basis for developing conclusions and recommendations. The available data must be properly organized in order to be comprehensive and useful. Organization of the data will be planned before it is collected to ensure the data generated are identifiable and usable.

Data will be generated from groundwater sampling and analysis, field analyses, field measurements, hydraulic testing, and other field activities. The individuals who generate data (geologists, engineers, samplers, field technicians, and chemical analysts) will be responsible for accurate and complete documentation of required data, as described in the FSP and SOPs.

The project data will be processed as follows:

- Field data sheets will be forwarded to the Field Task Manager.
- Samples for laboratory analysis will be sent directly from the field to the selected laboratory.
- Copies of chain-of-custody forms and other field data sheets will be forwarded to the Field Task Manager and Project QA Manager.
- Laboratory results, including Electronic Data Deliverables and hard copies, will be sent to the PDI Project Manager, Field Task Manager, Project QA Manager, and Data Manager.
- A third-party Data Validator will perform data validation with oversight by the Project QA Manager. The Data Manager will review the laboratory data packages and data validation sheets. The Data Validation Project Manager will provide oversight of the data validation process.

Data collected in the field will be accurately validated and then transferred to a data management system for evaluation.

9. PRE-DESIGN INVESTIGATION MILESTONES

The PDI Implementation schedule is as follows:

Deliverable or Action	Deadline
Begin PDI field tasks	30 Days after EPA approval of the PDIWP or 30 Days after the Effective Date ¹ , whichever is later
PDI Evaluation Report	60 Days after the final PDI groundwater sample is collected

1. In accordance with definitions established in the CD, the effective date is the date upon which the CD is entered by the Court as recorded on the Court docket.

10. REFERENCES

- California Department of Water Resources (CDWR), 1961. "Ground water geology", Appendix A of Planned utilization of the ground water basins of the coastal plain of Los Angeles County. California Department of Water Resources Bulletin 104.
- CH2M Hill, 2010. Final Remedial Investigation/Feasibility Study Reports, Omega Chemical Corporation Superfund Site, Operable Unit 2, Los Angeles County, California. Prepared for United States Environmental Protection Agency. August 2010.
- EPA, 2011. Interim Action Record of Decision, Omega Corporation Superfund Site, Operable Unit 2, Los Angeles County, California, EPA ID: CAD042245001. September 20, 2011.
- EPA, 2016a. Consent Decree regarding Operable Unit 2 at the Omega Chemical Corporation Superfund Site, Case 2:16-cv-02696 Document 4-1. Filed with United States District Court, Central District of California, Western Division. April 20, 2016.
- EPA, 2016b. Declaration for the Explanation of Significant Differences, Omega Chemical Corporation Site, Operable Unit 2, Los Angeles County, California. June 10, 2016.



TABLES



TABLE 1

Main Chemicals of Concern and Key Treatment Constituents

Main Chemicals of Concern (COCs)	
Volatile Organic Compounds	Trichloroethene (TCE)
	Tetrachloroethene / Perchloroethene (PCE)
	Trichlorofluoromethane (Freon 11)
	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
	1,1-Dichloroethene (1,1-DCE)
	cis-1,2-Dichloroethene (cis-1,2-DCE)
	chloroform
	carbon tetrachloride
	1,1-Dichloroethane (1,1-DCA)
	1,2-Dichloroethane (1,2-DCA)
	1,1,2-Trichloroethane (1,1,2-TCA)
Other	1,4-dioxane
	hexavalent chromium

Key Treatment Constituents	
Metals	Aluminum
	Total Chromium
	Manganese
	Selenium
General Chemistry	Nitrate
	Sulfate
	Total dissolved solids
Other	bis(2-Ethylhexyl)phthalate
	Perchlorate

TABLE 2

SUMMARY OF CORRELATION BETWEEN PRE-DESIGN INVESTIGATION REQUIREMENTS AND PLANNED TASKS

CD SOW Requirements for Data Evaluation [CD SOW Section 3.3(a)(i- iv)]	Data Needed		Task Identified to Collect Data	Data To Be Collected
(i) Define the areas and depths targeted for hydraulic control in the NE and CE Areas	Analytical results for COCs to define target zones in NE/CE Area		2,3	Initial and confirmation groundwater samples analyzed for COCs from 24 new PDI monitor wells in respective areas
			6	Periodic groundwater samples analyzed for COCs from 24 new PDI monitor wells and selected existing EPA/WRD monitor wells in respective areas
(ii) Estimate hydraulic conductivity in the NE/CE Area capture zone	Hydraulic conductivity and transmissivity of the target hydrostratigraphic units		5	Hydraulic testing of 24 new PDI monitor wells in vicinity of respective areas
(iii) Select groundwater extraction rates and locations for design of the remedy	Target zone defined from SOW item i above		2,3,6	See above
	Hydraulic testing from SOW item ii above		5	See above
	Direction of groundwater flow and hydraulic gradients		1,2,3 and 6	Periodic/transducer water level measurements in EPA/WRD monitor wells and 24 new PDI monitor wells
(iv) Address any concerns about the quantity, quality, completeness, or usability of water quality or other data upon which the design will be based	Refine understanding of hydrostratigraphic units	Borehole geophysical logs and lithologic logs	2,3,4	Geophysical and/or lithologic logs from 7 exploratory boreholes and monitor wells in NE/CE Area and lithologic logs from 4 monitor wells in candidate reinjection area
		Similarities/differences in water level elevations/trends in monitor wells	1, 2, 3, 4, 6	Periodic/transducer water level measurements in existing EPA/WRD wells and 28 new PDI wells
	Treated groundwater End Use evaluation	Key Treatment Constituents, emergent compounds and permit water quality parameters from extraction well field	2,3,6	Confirmation and contemporaneous groundwater samples analyzed for wide suite of constituents from 24 new PDI monitor wells and contemporaneous groundwater samples analyzed for wide suite of constituents from selected EPA/WRD monitor wells in respective areas
		COCs, Key Treatment Constituents, emergent compounds and permit water quality parameters in vicinity of reinjection wellfield	4	Initial and confirmation groundwater samples analyzed for COCs and confirmation sample analyzed for wide suite of constituents from 4 new PDI monitor wells in respective area
		Hydraulic properties and potential injection well fouling	5	Hydraulic testing of 4 new PDI monitor wells and pilot injection of potable water into 1 PDI pilot injection well in respective area
		Capacity of reclaim and spreading basins	NA	Meet with owner/operators of reclaim and spreading basin
		Permitting requirements for respective end use	NA	Meet with permitting agencies for reinjection, reclaim and spreading basin
	Treatment System Design	Influent Flow using information from SOW item iii above	1,2,3,5,6	See above
		COCs influent concentration	2,3,5,6	Combination of groundwater samples collected from monitor wells within the NE/CE Area target zone and respective estimated groundwater extraction rates
		Key Treatment Constituents, treatment system design, emergent compounds and permit water quality parameters to meet end use requirements	2,3,5,6	Use permitting requirements for respective end use and results of groundwater samples collected and analyzed for wide suite of compounds, including but not limited to water quality parameters influencing performance of respective treatment system process, from monitor wells within the NE/CE Area target zone and respective estimated groundwater extraction rates

CD Consent Decree lodged April 20, 2016 covering Operable Unit 2 at the Omega Chemical Corporation Superfund Site

CE Central extraction area (The location of the CE area is depicted in Appendix C of the CD as the area between the NE and Telegraph Road.)

COCs Chemicals of Concern

EPA United States Environmental Protection Agency

NE Northern extraction area (The location of the NE area is depicted in Appendix C of the CD in the vicinity of Sorenson Avenue)

PDI Pre-Design Investigation

WRD Water Replenishment District of Southern California

SOW Statement of Work, Appendix B of the CD

NE/CE Area A portion of the area of the groundwater contamination identified by EPA as Operable Unit 2 in its 2011 Record of Decision (2011 ROD). The NE/CE Area is depicted in Appendix C to the CD and is the area north of Telegraph Road. It includes the NE and CE Areas as depicted in the 2011 ROD as well as the northern portion of the Leading Edge Area as depicted in the 2011 ROD.

TABLE 3

EXISTING AND PRE-DESIGN INVESTIGATION WATER LEVEL MONITORING PROGRAM

Well Identifier	AREA	LSE (feet msl)	MPE (feet msl)	Screen Interval (feet bls)	HydroUnit		OBJECTIVES			MONITORING METHOD		
					EPA	DWR	HSU ^a	NE/CE ^{b,c}	INJ ^d	Early Transducer ¹	PDI Transducer ²	Periodic Manual ³
EXISTING												
MW-1A	RD	157.8	157.71	45 - 60	2	Gs	S					X
MW-1B	RD	158.1	158.05	75 - 85.4	2, 3	Gs	S					X
MW-2	RD	154.2	154.21	45 - 60	2	Gs	S	X				X
MW-3	RD	151.9	151.48	38 - 48	2	UN	S					X
MW-4A	RD	147.0	146.80	42.7 - 53	2	Gs	S	X				X
MW-4B	RD	147.0	146.84	69.7 - 80	3	Gs	S	X				X
MW-4C	RD	147.4	147.10	88.7 - 99	3	H	S	X				X
MW-5	RD	150.8	150.60	43.3 - 53.3	2	Gs	S	X				X
MW-6	RD	150.4	150.28	37.1 - 47.5	2	Gs	S	X				X
MW-7	RD	143.6	143.28	35.8 - 46	2, 3	Ga	S					X
MW-8A	NE	150.4	150.14	30 - 45	2	Gs	S	X				X
MW-8B	NE	150.3	150.03	65 - 75	3	Gs	P	X		X		X
MW-8C	NE	150.3	150.03	86.7 - 91.7	3	Gs	S	X				X
MW-8D	NE	150.1	149.91	110 - 120	3, 4	H	P	X		X		X
MW-9A	RD	148.9	148.84	25 - 35	2	Gs	S	X				X
MW-9B	RD	149.1	148.90	49.8 - 60	2	Gs	S	X				X
MW-10	RD	147.4	147.45	52 - 62	3	Ga	S	X				X
MW-11	RD	150.9	150.89	40 - 50	3	Ga	S	X				X
MW-12	RD	220.5	220.87	82 - 97	2, 3	UN	S					X
MW-13A	RD	206.3	206.02	56 - 66	2	UN	S					X
MW-13B	RD	206.3	205.88	123 - 133	3, 4	UN	S					X
MW-14	RD	173.0	172.63	60 - 75	2	Gs	S					X
MW-15	RD	148.7	148.28	50 - 70	2, 3	Gs	S	X				X
MW-16A	RD	153.5	153.19	45 - 60	3	Ga	S	X				X
MW-16B	RD	153.5	153.19	106 - 116	4, 5	H	P	X		X		X
MW-16C	RD	153.5	153.26	149 - 164	6	J-L UN	S	TBD				X

TABLE 3

EXISTING AND PRE-DESIGN INVESTIGATION WATER LEVEL MONITORING PROGRAM

Well Identifier	AREA	LSE (feet msl)	MPE (feet msl)	Screen Interval (feet bls)	HydroUnit		OBJECTIVES			MONITORING METHOD		
					EPA	DWR	HSU ^a	NE/CE ^{b,c}	INJ ^d	Early Transducer ¹	PDI Transducer ²	Periodic Manual ³
EXISTING (continued)												
MW-17A	RD	159.4	159.03	56 - 71	3	Ga, H	S	X				X
MW-17B	RD	159.4	158.90	94 - 104	4	H	P	X		X		X
MW-17C	RD	159.4	159.00	172 - 182	6	L	P	X		X		X
MW-18A	NE	144.3	143.73	56 - 71	3, 4	H	P	X		X		X
MW-18B	NE	144.3	143.83	90 - 100	5	H-J UN	S	X				X
MW-18C	NE	144.3	143.83	146 - 161	6	J-L UN	P	X		X		X
MW-19	RD	159.0	158.73	56 - 71	3	Ga	S					X
MW-20A	CE	142.1	141.31	75 - 90	3	Ga	S	X				X
MW-20B	CE	142.1	141.32	122 - 132	4	H	P	X		X		X
MW-20C	CE	142.1	141.35	180 - 190	6	J	P	X		X		X
MW-21	RD	129.3	128.81	64 - 79	3	Gs	S	X				X
MW-22	RD	151.5	150.82	74 - 89	3	Ga-H UN	S					X
MW-23A	NE	149.1	148.76	35 - 55	2	Gs	S	X				X
MW-23B	NE	149.4	149.06	82 - 97	3	Gs	P	X		X		X
MW-23C	NE	149.4	149.07	145 - 160	5	J	P	X		X		X
MW-23D	NE	149.4	148.04	175 - 185	6	J-L UN	P	X		X		X
MW-24A	RD	162.4	162.04	50 - 70	2	Gs	P			X		X
MW-24B	RD	162.4	162.03	110 - 125	3	Ga-H UN	S					X
MW-24C	RD	162.4	162.02	140 - 160	4, 5	J	P			X		X
MW-24D	RD	162.4	162.05	173 - 178	6	L	S					X
MW-25A	NE	148.3	147.90	45 - 65	3	Ga	S	X				X
MW-25B	NE	148.3	147.84	90 - 110	4, 5	H	P	X		X		X
MW-25C	NE	148.3	147.86	140 - 150	6	J-L UN	S	X				X
MW-25D	NE	148.3	147.87	194 - 209	Deep	L	P	X		X		X

TABLE 3

EXISTING AND PRE-DESIGN INVESTIGATION WATER LEVEL MONITORING PROGRAM

Well Identifier	AREA	LSE (feet msl)	MPE (feet msl)	Screen Interval (feet bls)	HydroUnit		OBJECTIVES			MONITORING METHOD		
					EPA	DWR	HSU ^a	NE/CE ^{b,c}	INJ ^d	Early Transducer ¹	PDI Transducer ²	Periodic Manual ³
EXISTING (continued)												
MW-26A	RD	156.0	155.62	70 - 90	3	H	P			X		X
MW-26B	RD	156.0	155.45	105 - 120	4	H	S					X
MW-26C	RD	156.0	155.41	145 - 160	6	J	P			X		X
MW-26D	RD	156.0	155.37	185 - 205	6	L	P			X		X
MW-27A	RD*	139.5	139.24	90 - 110	3	Ga	P	X		X		X
MW-27B	RD*	139.5	139.18	144 - 164	4	H	P	X		X		X
MW-27C	RD*	139.5	139.17	180 - 190	5	H	P	X		X		X
MW-27D	RD*	139.5	139.13	200 - 210	5, 6	H-J UN	P	TBD		X		X
MW-31	RD	233.0	232.67	106 - 121	3	UN	S					X
SFS_Hawkins_1a_1	RD	147.8	147.40	480 - 490	Deep	Deep	P			X		X
SFS_Hawkins_1b_2	RD	147.8	147.30	378 - 388	Deep	Deep	P			X		X
SFS_Hawkins_1c_3	CE	147.8	147.19	286 - 296	Deep	L	P	X		X		X
SFS_Hawkins_1c_4	CE	147.8	147.18	242 - 252	6	J-L UN	P	X		X		X
SFS_Hawkins_1c_5	CE	147.8	147.20	168 - 178	5	H-J UN	P	X		X		X
PRE-DESIGN INVESTIGATION MONITOR WELL												
NE-1 MWA	NE	TBD	TBD	50 - 100	2/3	Gs	P	X			X	X
NE-1 MWB	NE	TBD	TBD	120 - 150	3	H	P	X			X	X
NE-1 MWC	NE	TBD	TBD	160 - 180	4	J	P	TBD			X	X
NE-1 MWD	NE	TBD	TBD	200 - 250	5/6	L	P	TBD			X	X
NE-2 MWA	NE	TBD	TBD	50 - 90	2	Gs	P	X			X	X
NE-2 MWB	NE	TBD	TBD	100 - 120	3	H	P	X			X	X
NE-2 MWC	NE	TBD	TBD	130 - 150	4	J	P	TBD			X	X
NE-2 MWD	NE	TBD	TBD	200 - 250	5/6	L	P	TBD			X	X

TABLE 3

EXISTING AND PRE-DESIGN INVESTIGATION WATER LEVEL MONITORING PROGRAM

Well Identifier	AREA	LSE (feet msl)	MPE (feet msl)	Screen Interval (feet bls)	HydroUnit		OBJECTIVES			MONITORING METHOD		
					EPA	DWR	HSU ^a	NE/CE ^{b,c}	INJ ^d	Early Transducer ¹	PDI Transducer ²	Periodic Manual ³
PRE-DESIGN INVESTIGATION MONITOR WELL (continued)												
NE-3 MWA	NE	TBD	TBD	50 - 70	2	Ga	P	X			X	X
NE-3 MWB	NE	TBD	TBD	80 - 100	3	H	P	X			X	X
NE-3 MWC	NE	TBD	TBD	120 - 140	4	J	P	TBD			X	X
CE-1 MWA	CE	TBD	TBD	100 - 120	3/4	WT	P	X			X	X
CE-1 MWB	CE	TBD	TBD	140 - 170	4	H	P	X			X	X
CE-1 MWC	CE	TBD	TBD	200 - 250	5/6	J	P	TBD			X	X
CE-2 MWA	CE	TBD	TBD	100 - 120	3/4	WT	P	X			X	X
CE-2 MWB	CE	TBD	TBD	140 - 170	4	H	P	X			X	X
CE-2 MWC	CE	TBD	TBD	200 - 250	5/6	J	P	TBD			X	X
CE-3 MWA	CE	TBD	TBD	100 - 120	3/4	WT	P	X			X	X
CE-3 MWB	CE	TBD	TBD	140 - 170	5	H	P	X			X	X
CE-3 MWC	CE	TBD	TBD	200 - 250	6	J	P	TBD			X	X
CE-4 MWA	CE	TBD	TBD	100 - 140	4	H	P	X			X	X
CE-5 MWA	CE	TBD	TBD	100 - 120	3/4	WT	P	X			X	X
CE-5 MWB	CE	TBD	TBD	140 - 170	5	H	P	X			X	X
CE-5 MWC	CE	TBD	TBD	200 - 250	6	J	P	TBD			X	X
INJ-1 MWA	PR	TBD	TBD	60 - 120	3	Gs	P		X		X	X
INJ-2 MWA	PR	TBD	TBD	60 - 120	3	Gs	P		X		X	X
INJ-3 MWA	PR	TBD	TBD	60 - 110	3	Gs	P		X		X	X
INJ-4 MWA	PR	TBD	TBD	60 - 100	3	Gs	P		X		X	X

TABLE 3

EXISTING AND PRE-DESIGN INVESTIGATION WATER LEVEL MONITORING PROGRAM

Well Identifier	AREA	LSE (feet msl)	MPE (feet msl)	Screen Interval (feet bls)	HydroUnit		OBJECTIVES			MONITORING METHOD		
					EPA	DWR	HSU ^a	NE/CE ^{b,c}	INJ ^d	Early Transducer ¹	PDI Transducer ²	Periodic Manual ³
PRE-DESIGN INVESTIGATION MONITOR WELL (continued)												
CINJ-1 MWA	CR	TBD	TBD	100 - 170	3/4	Ga	TBD		TBD		TBD	TBD
CINJ-2 MWA	CR	TBD	TBD	100 - 150	3/4	Ga	TBD		TBD		TBD	TBD
CINJ-3 MWA	CR	TBD	TBD	100 - 110	3/4	Ga	TBD		TBD		TBD	TBD

AREA EXPLANATION

CE Central Extraction Area
 CR Contingency Reinjection Area
 NE Northern Extraction Area
 PR Primary Reinjection Area
 RD Remedial Design Work Area
 RD* Near RD Work Area

GENERAL

TBD To be determined
 msl mean sea level
 bls below land surface
 EPA U.S. Environmental Protection Agency
 DWR California Department of Water Resources
 HSU Hydrostratigraphic Unit
 LSE Land surface elevation
 MPE Measureing point elevation
 PDI Pre-Design Investigation

HYDROUNIT EXPLANATION

Gs Gaspur aquifer
 Ga Gage aquifer
 H Hollydale
 J Jefferson aquifer
 L Lynwood aquifer
 UN Undifferentiated
 Y-Z UN Undifferentiated between overlying aquifer (Y) and underling aquifer (Z)
 WT Water table (may not be in aquifer)
 Deep Below Lynwood aquifer or EPA SB6

OBJECTIVES

- ^a Refine the understanding of hydrostratigraphic units
 - ^b Assist in locating extraction wells
 - ^c Support development of estimate groundwater extraction rates
 - ^d Depth to water and flow direction in candidate reinjection area
- P or S Primary or secondary

¹ Installed in existing monitor wells during PDI monitor well permitting, transferred to PDI monitor well after PDI monitor well installed

² Monitored throughout PDI from time of PDI monitor well installation to time PDI final groundwater sample collected

³ Quarterly manual measurements/transducer downloads until PDI final groundwater sample collected

TABLE 4
PRE-DESIGN INVESTIGATION EXPLORATORY BOREHOLE AND MONITOR WELL SUMMARY

LOCATION	IDENTIFIER	FEATURE	TARGET INTERVAL	HYDROSTRATIGRAPHIC UNITS	DECISION CRITERIA FOR ADDITIONAL INVESTIGATION
Slauson Avenue west side of OU2	NE-1 EB	Exploratory Borehole	Through bottom of Lynwood / EPA SB6 (375 feet, bottom of EPA SB6 deeper than bottom of Lynwood aquifer)	B104: Gaspur (Gage aquifer may be merged with Gaspur aquifer or eroded off); Hollydale; Jefferson and Lynwood aquifers EPA: SB2 to SB6	No additional exploratory boreholes to east as existing/new monitor well coverage is adequate, no additional investigation to west given proximity of western edge of OU2. Potential deeper exploratory boring installation if deepest monitor well average COC concentration exceeds MCL (or NL for 1,4-dioxane) and existing lithologic information from original exploratory borehole not deep enough to design deeper monitor well.
	NE-1 MWA	Monitor Well	Gaspur aquifer (may be merged with Gage aquifer): first shallow aquifer near water table (50 to 100 feet)	B104: Gaspur aquifer EPA: SB2/Upper portion of SB3	No additional monitor wells to east as additional coverage with new/existing wells is adequate, no additional investigation to west given proximity of western edge of OU2. No additional deeper monitor wells as new Hollydale monitor well in cluster provides vertical control.
	NE-1 MWB	Monitor Well	Hollydale aquifer: next aquifer beneath Gaspur aquifer (120 to 150 feet)	B104: Hollydale aquifer EPA: SB3	No additional monitor wells to east as additional coverage with new/existing wells is adequate, no additional investigation to west given proximity of western edge of OU2. No additional deeper monitor wells as new Jefferson monitor well in cluster provides vertical control.
	NE-1 MWC	Monitor Well	Jefferson aquifer: next aquifer beneath Hollydale aquifer (160 to 180 feet)	B104: Jefferson aquifer EPA: SB4	No additional monitor wells to east as additional coverage with new/existing wells is adequate, no additional investigation to west given proximity of western edge of OU2. No additional deeper monitor wells as new Lynwood monitor well in cluster provides vertical control.
	NE-1 MWD	Monitor Well	Lynwood aquifer: next aquifer beneath Jefferson aquifer (may be as deep as 200 to 250, could be shallower). This is one of two Lynwood monitor wells designed to assess vertical extent of COCs in vicinity of EPA monitor well MW-23D	B104: Lynwood aquifer EPA: SB5/Upper portion of SB6	No additional monitor wells to east as additional coverage with new/existing wells is adequate, no additional investigation to west given proximity of western edge of OU2. Potential contingency deeper monitor well in deeper interval(s) if average of Lynwood monitor well results for COCs exceeds MCL (or NL in case of 1,4-dioxane). If deeper contingency monitor well(s) indicates average concentrations of COCs exceeds MCL (or NL in case of 1,4-dioxane), additional contingency deeper monitor wells may be required vertically.
Sorensen Avenue near Baker Place	NE-2 EB	Exploratory Borehole	Through bottom of Lynwood / EPA SB6 (375 feet, bottom of EPA SB6 deeper than bottom of Lynwood aquifer)	B104: Gaspur (Gage aquifer may be merged with Gaspur aquifer or eroded off); Hollydale; Jefferson and Lynwood aquifers EPA: SB2 to SB6	No additional exploratory boreholes to east or west as the coverage with existing/new wells is adequate. Potential deeper exploratory boring installation if deepest monitor well average COC concentration exceeds MCL or NL and existing lithologic information from original exploratory borehole not deep enough to design deeper monitor well.
	NE-2 MWA	Monitor Well	Gaspur aquifer (may be merged with Gage aquifer): first shallow aquifer near water table (50 to 90 feet)	B104: Gaspur aquifer EPA: SB2	No additional monitor wells to east or west as additional coverage with new/existing wells is adequate. No additional deeper monitor wells as new Hollydale monitor well in cluster provides vertical control.
	NE-2 MWB	Monitor Well	Hollydale aquifer: next aquifer beneath Gaspur aquifer (100 to 120 feet)	B104: Hollydale aquifer EPA: SB3	No additional monitor wells to east or west as additional coverage with new/existing wells is adequate. No additional deeper monitor wells as new Jefferson monitor well in cluster provides vertical control.
	NE-2 MWC	Monitor Well	Jefferson aquifer: next aquifer beneath Hollydale aquifer (130 to 150 feet)	B104: Jefferson aquifer EPA: SB4	No additional monitor wells to east or west as additional coverage with new/existing wells is adequate. No additional deeper monitor wells as new Lynwood monitor well in cluster provides vertical control.
	NE-2 MWD	Monitor Well	Lynwood aquifer: next aquifer beneath Jefferson aquifer (may be as deep as 200 to 250, could be shallower). This is one of two Lynwood monitor wells designed to assess vertical extent of COCs in vicinity of EPA monitor well MW-23D	B104: Lynwood aquifer EPA: SB5/Upper portion of SB6	No additional monitor wells to east or west as additional coverage with new/existing wells is adequate. Potential contingency deeper monitor well in deeper interval(s) if average of Lynwood monitor well results for COCs exceeds MCL or NL. If deeper contingency monitor well(s) indicates concentrations of COCs exceeds MCL or NL, additional contingency deeper monitor wells may be required vertically.

TABLE 4
PRE-DESIGN INVESTIGATION EXPLORATORY BOREHOLE AND MONITOR WELL SUMMARY

LOCATION	IDENTIFIER	FEATURE	TARGET INTERVAL	HYDROSTRATIGRAPHIC UNITS	DECISION CRITERIA FOR ADDITIONAL INVESTIGATION
Sorensen Avenue to west of John Street	NE-3 EB	Exploratory Borehole	Through bottom of Lynwood / EPA SB6 (300 feet, bottom of EPA SB6 deeper than bottom of Lynwood aquifer)	B104: Gage; Hollydale; Jefferson and Lynwood aquifers (Gaspur aquifer not present or unsaturated) EPA: SB2 to SB6	No additional exploratory boreholes to east or west as the coverage with existing/new wells is adequate. Potential deeper exploratory boring installation if deepest monitor well average COC concentration exceeds MCL or NL and existing lithologic information from original exploratory borehole not deep enough to design deeper monitor well.
	NE-3 MWA	Monitor Well	Gage aquifer: first shallow aquifer near water table (50 to 70 feet)	B104: Gage aquifer EPA: SB2	No additional monitor wells to east or west as additional coverage with new/existing wells is adequate. No additional deeper monitor wells as new Hollydale monitor well in cluster provides vertical control.
	NE-3 MWB	Monitor Well	Hollydale aquifer: next aquifer beneath Gage aquifer (80 to 100 feet)	B104: Hollydale aquifer EPA: SB3	No additional monitor wells to east or west as additional coverage with new/existing wells is adequate. No additional deeper monitor wells as new Jefferson monitor well in cluster provides vertical control.
	NE-3 MWC	Monitor Well	Jefferson aquifer: next aquifer beneath Hollydale aquifer (120 to 140 feet)	B104: Jefferson aquifer EPA: SB4	No additional monitor wells to east or west as additional coverage with new/existing wells is adequate. Potential contingency deeper monitor well in Lynwood if average of Jefferson monitor well results for COCs exceeds MCL or NL. If deeper contingency monitor well(s) indicates concentrations of COCs exceeds MCL or NL, additional contingency deeper monitor wells may be required vertically.
Telegraph Road on west side of OU2	CE-1 EB	Exploratory Borehole	Through bottom of Lynwood / EPA SB6 (425 feet, bottom of EPA SB6 deeper than bottom of Lynwood aquifer)	B104: Gage (may be unsaturated); Hollydale; Jefferson and Lynwood aquifers (Gaspur aquifer not unsaturated; Artesia aquifer not present) EPA: SB3 to SB6	No additional exploratory boreholes to east as the coverage with existing/new wells is adequate, no additional investigation to west given proximity of western edge of OU2. Potential deeper exploratory boring installation if deepest monitor well average COC concentration exceeds MCL or NL and existing lithologic information from original exploratory borehole not deep enough to design deeper monitor well.
	CE-1 MWA	Monitor Well	Water table beneath Gage aquifer (Gage aquifer likely unsaturated) (100 to 120 feet)	B104: Between Gage and Hollydale aquifers (water table) EPA: SB3/SB4 (SB3 may be unsaturated)	No additional monitor wells to east as additional coverage with new/existing wells is adequate, no additional investigation to west given proximity of western edge OU2. No additional deeper monitor wells as new Hollydale monitor well in cluster provides vertical control.
	CE-1 MWB	Monitor Well	Hollydale aquifer: next aquifer beneath Gage aquifer (140 to 170 feet)	B104: Hollydale aquifer EPA: SB4	No additional monitor wells to east as additional coverage with new/existing wells is adequate, no additional investigation to west given proximity of western edge of OU2. No additional deeper monitor wells as new Jefferson monitor well in cluster provides vertical control.
	CE-1 MWC	Monitor Well	Jefferson aquifer: next aquifer beneath Hollydale aquifer (200 to 250 feet)	B104: Jefferson aquifer EPA: SB5/Upper portion of SB6	No additional monitor wells to east as additional coverage with new/existing wells is adequate, no additional investigation to west given proximity of western edge OU2. Potential contingency deeper monitor well in Lynwood aquifer if average of Jefferson monitor well results for COCs exceeds MCL or NL. If deeper contingency monitor well(s) indicates concentrations of COCs exceeds MCL or NL, additional contingency deeper monitor wells may be required vertically.

TABLE 4
PRE-DESIGN INVESTIGATION EXPLORATORY BOREHOLE AND MONITOR WELL SUMMARY

LOCATION	IDENTIFIER	FEATURE	TARGET INTERVAL	HYDROSTRATIGRAPHIC UNITS	DECISION CRITERIA FOR ADDITIONAL INVESTIGATION
Telegraph Road to west of Matern Place	CE-2 EB	Exploratory Borehole	Through bottom of Lynwood / EPA SB6 (400 feet, bottom of EPA SB6 deeper than bottom of Lynwood aquifer)	B104: Gage (may be unsaturated); Hollydale; Jefferson and Lynwood aquifers (Gaspur aquifer not unsaturated; Artesia aquifer not present) EPA: SB3 to SB6	No additional exploratory boreholes to east or west as the coverage with existing/new wells is adequate. Potential deeper exploratory boring installation if deepest monitor well average COCs concentration exceeds MCL or NL and existing lithologic information from original exploratory borehole not deep enough to design deeper monitor well.
	CE-2 MWA	Monitor Well	Water table beneath Gage aquifer (Gage aquifer likely unsaturated) (100 to 120 feet)	B104: Between Gage and Hollydale aquifers (water table) EPA: SB3/SB4 (SB3 may be unsaturated)	No additional monitor wells to east or west as the coverage with existing/new wells is adequate. No additional deeper monitor wells as new Hollydale monitor well in cluster provides vertical control.
	CE-2 MWB	Monitor Well	Hollydale aquifer: next aquifer beneath Gage aquifer (140 to 170 feet)	B104: Hollydale aquifer EPA: SB4	No additional monitor wells to east or west as the coverage with existing/new wells is adequate. No additional deeper monitor wells as new Jefferson monitor well in cluster provides vertical control.
	CE-2 MWC	Monitor Well	Jefferson aquifer: next aquifer beneath Hollydale aquifer (200 to 250 feet)	B104: Jefferson aquifer EPA: SB5/Upper portion of SB6	No additional monitor wells to east or west as the coverage with existing/new wells is adequate. Potential contingency deeper monitor well in Lynwood aquifer if average of Jefferson monitor well results for COCs exceeds MCL or NL. If deeper contingency monitor well(s) indicates concentrations of COCs exceeds MCL or NL, additional contingency deeper monitor wells may be required vertically.
Telegraph Road near Matern Place	CE-3 EB	Exploratory Borehole	Through bottom of Lynwood / EPA SB6 (375 feet, bottom of EPA SB6 deeper than bottom of Lynwood aquifer)	B104: Gage (may be unsaturated); Hollydale; Jefferson and Lynwood aquifers (Gaspur and/or Artesia aquifers not present or unsaturated) EPA: SB3 to SB6	No additional exploratory boreholes to east or west as the coverage with existing/new wells is adequate. Potential deeper exploratory boring installation if deepest monitor well average COCs concentration exceeds MCL or NL and existing lithologic information from original exploratory borehole not deep enough to design deeper monitor well.
	CE-3 MWA	Monitor Well	Water table beneath Gage aquifer (Gage aquifer likely unsaturated) (100 to 120 feet)	B104: Between Gage and Hollydale aquifers (water table) EPA: SB3/SB4 (SB3 may be unsaturated)	No additional exploratory boreholes to east or west as the coverage with existing/new wells is adequate. No additional deeper monitor wells as new Hollydale monitor well in cluster provides vertical control.
	CE-3 MWB	Monitor Well	Hollydale aquifer: next aquifer beneath Gage aquifer (140 to 170 feet)	B104: Hollydale aquifer EPA: SB5	No additional exploratory boreholes to east or west as the coverage with existing/new wells is adequate. No additional deeper monitor wells as new Jefferson monitor well in cluster provides vertical control.
	CE-3 MWC	Monitor Well	Jefferson aquifer: next aquifer beneath Hollydale aquifer (200 to 250 feet)	B104: Jefferson aquifer EPA: SB6	No additional exploratory boreholes to east or west as the coverage with existing/new wells is adequate. Potential contingency deeper monitor well in Lynwood aquifer if average of Jefferson monitor well results for COCs exceeds MCL or NL. If deeper contingency monitor well(s) indicates concentrations of COCs exceeds MCL or NL, additional contingency deeper monitor wells may be required vertically.
Near Hawkins Well Cluster	CE-4 MWA	Monitor Well	Water table to Hollydale aquifer (100 to 140 feet)	B104: Hollydale aquifer EPA: SB4	No additional monitor wells to east or west as the coverage with existing/new wells is adequate. No additional deeper monitor wells as deeper well in Hawkins cluster provides vertical control.

TABLE 4**PRE-DESIGN INVESTIGATION EXPLORATORY BOREHOLE AND MONITOR WELL SUMMARY**

LOCATION	IDENTIFIER	FEATURE	TARGET INTERVAL	HYDROSTRATIGRAPHIC UNITS	DECISION CRITERIA FOR ADDITIONAL INVESTIGATION
Telegraph Road east side of OU2	CE-5 EB	Exploratory Borehole	Through bottom of Lynwood / EPA SB6 (350 feet, bottom of Lynwood aquifer deeper than bottom of EPA SB6)	B104: Gage (may be unsaturated); Hollydale; Jefferson and Lynwood aquifers (Gaspur aquifer not present and Artesia aquifer not unsaturated) EPA: SB3 to SB6	No additional exploratory boreholes to west as the coverage with existing/new wells is adequate, no additional investigation to east given proximity of eastern edge of OU2. Potential deeper exploratory boring installation if deepest monitor well average COCs concentration exceeds MCL or NL and existing lithologic information from original exploratory borehole not deep enough to design deeper monitor well.
	CE-5 MWA	Monitor Well	Water table beneath Gage aquifer (Gage aquifer likely unsaturated) (100 to 120 feet)	B104: Between Gage and Hollydale aquifers (water table) EPA: SB3/SB4	No additional monitor wells to west as additional coverage with new/existing wells is adequate, no additional investigation to east given proximity of eastern edge of OU2. No additional deeper monitor wells as new Hollydale monitor well in cluster provides vertical control.
	CE-5 MWB	Monitor Well	Hollydale aquifer: next aquifer beneath Gage aquifer (140 to 170 feet)	B104: Hollydale aquifer EPA: SB5	No additional monitor wells to west as additional coverage with new/existing wells is adequate, no additional investigation to east given proximity of eastern edge of OU2. No additional deeper monitor wells as new Jefferson monitor well in cluster provides vertical control.
	CE-5 MWC	Monitor Well	Jefferson aquifer: next aquifer beneath Hollydale aquifer (200 to 250 feet)	B104: Jefferson aquifer EPA: SB6	No additional monitor wells to west as additional coverage with new/existing wells is adequate, no additional investigation to east given proximity of eastern edge of OU2. Potential contingency deeper monitor well in Lynwood aquifer if average of Jefferson monitor well results for COCs exceeds MCL or NL. If deeper contingency monitor well(s) indicates concentrations of COCs exceeds MCL or NL, additional contingency deeper monitor wells may be required vertically.
Riveria Road west of Duchess Dr	INJ-1 MWA	Monitor Well	Through bottom of Gaspur aquifer (60 to 120 feet)	B104: Gaspur aquifer EPA: SB3	No additional monitor wells in area. May add pilot injection well in vicinity of one of these monitor wells if initial hydraulic test and water quality data indicate this injection area is a potential candidate area, if this is the case the pilot injection well would be installed in the vicinity of the monitor well with the lowest hydraulic conductivity/transmissivity (INJ-1 to INJ-4). May need to evaluate contingency reinjection area if water quality data or hydraulic data do not support reinjection in this general area.
Slauson Avenue and Norwalk Avenue	INJ-2 MWA	Monitor Well	Through bottom of Gaspur aquifer (60 to 120 feet)	B104: Gaspur aquifer EPA: SB3	
Aeolian St and Westman Ave	INJ-3 MWA	Monitor Well	Through bottom of Gaspur aquifer (60 to 110 feet)	B104: Gaspur aquifer EPA: SB3	
Allport Ave and Washington Blvd	INJ-4 MWA	Monitor Well	Through bottom of Gaspur aquifer (60 to 100 feet)	B104: Gaspur aquifer EPA: SB3	
Alburtis Ave and Dunning St	CINJ-1 MWA	Monitor Well	Through bottom of Gage aquifer (100 to 170 feet)	B104: Gage aquifer EPA: SB3/SB4	Not planning on installing monitor wells in this area unless testing at INJ-1 to INJ-4 indicates that area is not suitable for injection and reinjection is not screened for further consideration. May add pilot injection well in vicinity of one of these monitor wells if initial hydraulic test and water quality data indicate this injection area is a potential candidate area, if this is the case the pilot injection well would be installed in the vicinity of the monitor well with the lowest hydraulic conductivity/transmissivity (CINJ 1 to CINJ-3). May need to evaluate alternate contingency reinjection area (not identified at this time) if water quality data or hydraulic data do not support reinjection in this general area.
Alburtis Ave and Telegraph Road	CINJ-2 MWA	Monitor Well	Through bottom of Gage aquifer (100 to 150 feet)	B104: Gage aquifer EPA: SB3/SB4	
Alburtis Ave and Pioneer Blvd	CINJ-3 MWA	Monitor Well	Through bottom of Gage aquifer (100 to 110 feet)	B104: Gage aquifer EPA: SB3/SB4	

OU2 Operable Unit 2 as defined in 2011 Record of Decision
COCs Chemicals of Concern
NL Notification Level
MCL Maximum Contaminant Level
EB Exploratory borehole
EPA Unites States Environmental Protection Agency
B104 California Department of Water Resources Bulletin 104.

TABLE 5

EXISTING AND PRE-DESIGN INVESTIGATION GROUNDWATER SAMPLE COLLECTION

Well Identifier	AREA	LSE (feet msl)	MPE (feet msl)	Screen Interval (feet bls)	HydroUnit		OBJECTIVES				SAMPLE EVENT			
					EPA	DWR	NE/CE Target Zone ^a	Rein ^j ^b	End Use ^c	Treatment ^d	Initial ¹	Confirmation ²	Periodic ³	Final ⁴
EXISTING														
MW-1A	RD	157.8	157.71	45 - 60	2	Gs							WAMP	
MW-1B	RD	158.1	158.05	75 - 85.4	2, 3	Gs							WAMP	
MW-2	RD	154.2	154.21	45 - 60	2	Gs							WAMP	
MW-3	RD	151.9	151.48	38 - 48	2	UN							WAMP	
MW-4A	RD	147.0	146.80	42.7 - 53	2	Gs							WAMP	
MW-4B	RD	147.0	146.84	69.7 - 80	3	Gs							WAMP	
MW-4C	RD	147.4	147.10	88.7 - 99	3	H							WAMP	
MW-5	RD	150.8	150.60	43.3 - 53.3	2	Gs							WAMP	
MW-6	RD	150.4	150.28	37.1 - 47.5	2	Gs							WAMP	
MW-7	RD	143.6	143.28	35.8 - 46	2, 3	Ga							WAMP	
MW-8A	NE	150.4	150.14	30 - 45	2	Gs	X			TBD			COCs	Mod or Long
MW-8B	NE	150.3	150.03	65 - 75	3	Gs	X			TBD			COCs	Mod or Long
MW-8C	NE	150.3	150.03	86.7 - 91.7	3	Gs	X			TBD			COCs	Mod or Long
MW-8D	NE	150.1	149.91	110 - 120	3, 4	H	X			TBD			COCs	Mod or Long
MW-9A	RD	148.9	148.84	25 - 35	2	Gs							WAMP	
MW-9B	RD	149.1	148.90	49.8 - 60	2	Gs							WAMP	
MW-10	RD	147.4	147.45	52 - 62	3	Ga							WAMP	
MW-11	RD	150.9	150.89	40 - 50	3	Ga							WAMP	
MW-12	RD	220.5	220.87	82 - 97	2, 3	UN							WAMP	
MW-13A	RD	206.3	206.02	56 - 66	2	UN							WAMP	
MW-13B	RD	206.3	205.88	123 - 133	3, 4	UN							WAMP	
MW-14	RD	173.0	172.63	60 - 75	2	Gs								
MW-15	RD	148.7	148.28	50 - 70	2, 3	Gs							WAMP	
MW-16A	RD	153.5	153.19	45 - 60	3	Ga							WAMP	
MW-16B	RD	153.5	153.19	106 - 116	4, 5	H							WAMP	
MW-16C	RD	153.5	153.26	149 - 164	6	J-L UN							WAMP	

TABLE 5

EXISTING AND PRE-DESIGN INVESTIGATION GROUNDWATER SAMPLE COLLECTION

Well Identifier	AREA	LSE (feet msl)	MPE (feet msl)	Screen Interval (feet bls)	HydroUnit		OBJECTIVES				SAMPLE EVENT			
					EPA	DWR	NE/CE Target Zone ^a	Rein ^j ^b	End Use ^c	Treatment ^d	Initial ¹	Confirmation ²	Periodic ³	Final ⁴
EXISTING (continued)														
MW-17A	RD	159.4	159.03	56 - 71	3	Ga, H							WAMP	
MW-17B	RD	159.4	158.90	94 - 104	4	H							WAMP	
MW-17C	RD	159.4	159.00	172 - 182	6	L							WAMP	
MW-18A	NE	144.3	143.73	56 - 71	3, 4	H	X			TBD			COCs	Mod or Long
MW-18B	NE	144.3	143.83	90 - 100	5	H-J UN	X			TBD			COCs	Mod or Long
MW-18C	NE	144.3	143.83	146 - 161	6	J-L UN	X			TBD			COCs	Mod or Long
MW-19	RD	159.0	158.73	56 - 71	3	Ga							WAMP	
MW-20A	CE	142.1	141.31	75 - 90	3	Ga	X			TBD			COCs	Mod or Long
MW-20B	CE	142.1	141.32	122 - 132	4	H	X			TBD			COCs	Mod or Long
MW-20C	CE	142.1	141.35	180 - 190	6	J	X			TBD			COCs	Mod or Long
MW-21	RD	129.3	128.81	64 - 79	3	Gs							WAMP	
MW-22	RD	151.5	150.82	74 - 89	3	Ga-H UN							WAMP	
MW-23A	NE	149.1	148.76	35 - 55	2	Gs	X			TBD			COCs	Mod or Long
MW-23B	NE	149.4	149.06	82 - 97	3	Gs	X			TBD			COCs	Mod or Long
MW-23C	NE	149.4	149.07	145 - 160	5	J	X			TBD			COCs	Mod or Long
MW-23D	NE	149.4	148.04	175 - 185	6	J-L UN	X			TBD			COCs	Mod or Long
MW-24A	RD	162.4	162.04	50 - 70	2	Gs							WAMP	
MW-24B	RD	162.4	162.03	110 - 125	3	Ga-H UN							WAMP	
MW-24C	RD	162.4	162.02	140 - 160	4, 5	J							WAMP	
MW-24D	RD	162.4	162.05	173 - 178	6	L							WAMP	
MW-25A	NE	148.3	147.90	45 - 65	3	Ga	X			TBD			COCs	Mod or Long
MW-25B	NE	148.3	147.84	90 - 110	4, 5	H	X			TBD			COCs	Mod or Long
MW-25C	NE	148.3	147.86	140 - 150	6	J-L UN	X			TBD			COCs	Mod or Long
MW-25D	NE	148.3	147.87	194 - 209	Deep	L	X			TBD			COCs	Mod or Long

TABLE 5

EXISTING AND PRE-DESIGN INVESTIGATION GROUNDWATER SAMPLE COLLECTION

Well Identifier	AREA	LSE (feet msl)	MPE (feet msl)	Screen Interval (feet bls)	HydroUnit		OBJECTIVES				SAMPLE EVENT			
					EPA	DWR	NE/CE Target Zone ^a	Rein ^j ^b	End Use ^c	Treatment ^d	Initial ¹	Confirmation ²	Periodic ³	Final ⁴
EXISTING (continued)														
MW-26A	RD	156.0	155.62	70 - 90	3	H							WAMP	
MW-26B	RD	156.0	155.45	105 - 120	4	H							WAMP	
MW-26C	RD	156.0	155.41	145 - 160	6	J							WAMP	
MW-26D	RD	156.0	155.37	185 - 205	6	L							WAMP	
MW-27A		139.5	139.24	90 - 110	3	Ga							WAMP	
MW-27B		139.5	139.18	144 - 164	4	H							WAMP	
MW-27C		139.5	139.17	180 - 190	5	H							WAMP	
MW-27D		139.5	139.13	200 - 210	5, 6	H-J UN							WAMP	
MW-31	RD	233.0	232.67	106 - 121	3	UN							WAMP	
SFS_Hawkins_1a_1	RD	147.8	147.40	480 - 490	Deep	Deep							WAMP	
SFS_Hawkins_1b_2	RD	147.8	147.30	378 - 388	Deep	Deep							WAMP	
SFS_Hawkins_1c_3	CE	147.8	147.19	286 - 296	Deep	L	X			TBD			COCs	Mod or Long
SFS_Hawkins_1c_4	CE	147.8	147.18	242 - 252	6	J-L UN	X			TBD			COCs	Mod or Long
SFS_Hawkins_1c_5	CE	147.8	147.20	168 - 178	5	H-J UN	X			TBD			COCs	Mod or Long
PRE-DESIGN INVESTIGATION MONITOR WELL														
NE-1 MWA	NE	TBD	TBD	50 - 100	2/3	Gs	X			TBD	COCs	Mod List	COCs	Mod or Long
NE-1 MWB	NE	TBD	TBD	120 - 150	3	H	X			TBD	COCs	Mod List	COCs	Mod or Long
NE-1 MWC	NE	TBD	TBD	160 - 180	4	J	X			TBD	COCs	Mod List	COCs	Mod or Long
NE-1 MWD	NE	TBD	TBD	200 - 250	5/6	L	X			TBD	COCs	Mod List	COCs	Mod or Long
NE-2 MWA	NE	TBD	TBD	50 - 90	2	Gs	X			TBD	COCs	Mod List	COCs	Mod or Long
NE-2 MWB	NE	TBD	TBD	100 - 120	3	H	X			TBD	COCs	Mod List	COCs	Mod or Long
NE-2 MWC	NE	TBD	TBD	130 - 150	4	J	X			TBD	COCs	Mod List	COCs	Mod or Long
NE-2 MWD	NE	TBD	TBD	200 - 250	5/6	L	X			TBD	COCs	Mod List	COCs	Mod or Long

TABLE 5

EXISTING AND PRE-DESIGN INVESTIGATION GROUNDWATER SAMPLE COLLECTION

Well Identifier	AREA	LSE (feet msl)	MPE (feet msl)	Screen Interval (feet bls)	HydroUnit		OBJECTIVES				SAMPLE EVENT			
					EPA	DWR	NE/CE Target Zone ^a	Reinj ^b	End Use ^c	Treatment ^d	Initial ¹	Confirmation ²	Periodic ³	Final ⁴
PRE-DESIGN INVESTIGATION MONITOR WELL (continued)														
NE-3 MWA	NE	TBD	TBD	50 - 70	2	Ga	X			TBD	COCs	Mod List	COCs	Mod or Long
NE-3 MWB	NE	TBD	TBD	80 - 100	3	H	X			TBD	COCs	Mod List	COCs	Mod or Long
NE-3 MWC	NE	TBD	TBD	120 - 140	4	J	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-1 MWA	CE	TBD	TBD	100 - 120	3/4	WT	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-1 MWB	CE	TBD	TBD	140 - 170	4	H	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-1 MWC	CE	TBD	TBD	200 - 250	5/6	J	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-2 MWA	CE	TBD	TBD	100 - 120	3/4	WT	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-2 MWB	CE	TBD	TBD	140 - 170	4	H	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-2 MWC	CE	TBD	TBD	200 - 250	5/6	J	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-3 MWA	CE	TBD	TBD	100 - 120	3/4	WT	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-3 MWB	CE	TBD	TBD	140 - 170	5	H	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-3 MWC	CE	TBD	TBD	200 - 250	6	J	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-4 MWA	CE	TBD	TBD	100 - 140	4	H	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-5 MWA	CE	TBD	TBD	100 - 120	3/4	WT	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-5 MWB	CE	TBD	TBD	140 - 170	5	H	X			TBD	COCs	Mod List	COCs	Mod or Long
CE-5 MWC	CE	TBD	TBD	200 - 250	6	J	X			TBD	COCs	Mod List	COCs	Mod or Long
INJ-1 MWA	PR	TBD	TBD	60 - 120	3	Gs		X	X	X	Mod	Long	COCs	COCs
INJ-2 MWA	PR	TBD	TBD	60 - 120	3	Gs		X	X	X	Mod	Long	COCs	COCs
INJ-3 MWA	PR	TBD	TBD	60 - 110	3	Gs		X	X	X	Mod	Long	COCs	COCs
INJ-4 MWA	PR	TBD	TBD	60 - 100	3	Gs		X	X	X	Mod	Long	COCs	COCs

TABLE 5

EXISTING AND PRE-DESIGN INVESTIGATION GROUNDWATER SAMPLE COLLECTION

Well Identifier	AREA	LSE (feet msl)	MPE (feet msl)	Screen Interval (feet bls)	HydroUnit		OBJECTIVES				SAMPLE EVENT			
					EPA	DWR	NE/CE Target Zone ^a	Reinj ^b	End Use ^c	Treatment ^d	Initial ¹	Confirmation ²	Periodic ³	Final ⁴
PRE-DESIGN INVESTIGATION MONITOR WELL (continued)														
CINJ-1 MWA	CR	TBD	TBD	100 - 170	3/4	Ga		TBD	TBD	TBD	TBD	TBD	TBD	TBD
CINJ-2 MWA	CR	TBD	TBD	100 - 150	3/4	Ga		TBD	TBD	TBD	TBD	TBD	TBD	TBD
CINJ-3 MWA	CR	TBD	TBD	100 - 110	3/4	Ga		TBD	TBD	TBD	TBD	TBD	TBD	TBD

AREA EXPLANATION

CE Central Extraction Area
 CR Contingency Reinjection Area
 NE Northern Extraction Area
 PR Primary Reinjection Area
 RD Remedial Design Work Area

GENERAL

TBD To be determined
 msl mean sea level
 bls below land surface
 EPA U.S. Environmental Protection Agency
 DWR California Department of Water Resources
 LSE Land surface elevation
 MPE Measureing point elevation
 PDI Pre-Design Investigation
 WAMP Work Area Monitoring Program
 COCs Chemicals of concern

Mod COCs; key treatment constituents; general chemistry; treatment system design; and emergent compounds

Mod or Long Long (mod + permitting constituents) conducted on 6 NE and 6 CE wells, others Mod

HYDROUNIT EXPLANATION

Gs Gaspur aquifer
 Ga Gage aquifer
 H Hollydale
 J Jefferson aquifer
 L Lynwood aquifer
 UN Undifferentiated
 Y-Z UN Undifferentiated between overlying aquifer (Y) and underling aquifer (Z)
 WT Water table (may not be in aquifer)
 Deep Below Lynwood aquifer or EPA SB6

OBJECTIVES

- ^a Define the areas and depths targeted for hydraulic control in the NE and CE Areas
^b Determine if reinjection is viable, and if so, define areas and depths of reinjection
^c Support evaluation of end use(s) of treated groundwater
^d Design treatment system

¹ Collected within approximately 2 to 4 weeks of well construction

² Collected within approximately 6 weeks of initial sample collection

³ Starting the quarter after in the initial PDI monitor well is installed to the quarter the last PDI monitor well installed

⁴ Conducted after final PDI monitor well has been installed/initial sample collected, contemporaneous event

TABLE 6
GROUNDWATER ANALYTE LISTS

Constituent Group	Analyte Group	Compound/Constituent	CAS	OBJECTIVES			SAMPLE GROUP
				NE/CE Target Zones ¹	Treated Water End Use Evaluation ²	Treatment System Design ³	
COCs	VOCs (Main COCs and/or RI COPCs)	Trichloroethylene (TCE)	79-01-6				COCs, Moderate List, and Long List
		Tetrachloroethylene (PCE)	127-18-4				
		Trichlorofluoromethane (FREON 11)	75-69-4				
		Trichlorotrifluoroethane (FREON 113)	76-13-1				
		1,1-Dichloroethylene (1,1-DCE)	75-35-4				
		cis-1,2-Dichloroethylene (c-1,2-DCE)	156-59-2				
		Chloroform (Trichloromethane)	67-66-3				
		Carbon tetrachloride	56-23-5				
		1,1-Dichloroethane (1,1-DCA)	75-34-3				
		1,2-Dichloroethane (1,2-DCA)	107-06-2				
		1,1,1-Trichloroethane (1,1,1-TCA)	71-55-6				
		1,1,2,2-Tetrachloroethane	79-34-5				
		Dibromochloropropane (DBCP) ^c	96-12-6				
		Ethylene Dibromide (EDB) ^c	106-93-4				
		Benzene	71-43-2				
		Carbon disulfide ^d	75-15-0				
		Monochlorobenzene (Chlorobenzene)	108-90-7				
		cis-1,3-Dichloropropene	10061-01-5				
		Methyl tert-Butyl Ether (MTBE)	1634-04-4				
		Dichloromethane (Methylene Chloride) ^d	75-09-2				
		Toluene	108-88-3				
		trans-1,2-Dichloroethylene (t-1,2-DCE)	156-60-5				
		trans-1,3-dichloropropene	10061-02-6				
		Vinyl Chloride (VC)	75-01-4				
Key Treatment Constituents	Emergent Compounds	1,4-Dioxane	123-91-1				Moderate List and Long List
	Emergent Compounds	Chromium, hexavalent (CrVI)	18540-29-9				
	SVOCs	Bis (2-Ethylhexyl)phthalate	117-81-7				
	General Mineral	Aluminum (Al)	7429-90-5				
		Manganese (Mn)	7439-96-5				
		Selenium (Se)	7782-49-2				
		Chromium (Total Cr)	7440-47-3				
		Sulfate (SO ₄)	14808-79-8				
		Nitrate as Nitrogen (N)	14797-55-8				
		Total Dissolved Solids (TDS)	10-33-3				
	Emergent Compounds	Perchlorate	14797-73-0				

TABLE 6
GROUNDWATER ANALYTE LISTS

Constituent Group	Analyte Group	Compound/Constituent	CAS	OBJECTIVES			SAMPLE GROUP
				NE/CE Target Zones ¹	Treated Water End Use Evaluation ²	Treatment System Design ³	
General Chemistry ^a	General Mineral	Antimony	7440-36-0				Moderate List and Long List (continued)
		Arsenic	7440-38-2				
		Barium (Ba)	7440-39-3				
		Beryllium	7440-41-7				
		Cadmium (Cd)	7440-43-9				
		Cobalt	7440-48-4				
		Copper (Cu)	7440-50-8				
		Iron (Fe)	7439-89-6				
		Lead (Pb)	7439-92-1				
		Molybdenum	7439-98-7				
		Mercury (Hg)	7439-97-6				
		Nickel	7440-02-0				
		Silver (Ag)	7440-22-4				
		Thallium	7440-28-0				
		Vanadium	7440-62-2				
		Zinc (Zn)	7440-66-6				
		Chloride	16887-00-6				
		Alkalinity, (Total) (as CaCO ₃ equivalents)	TOT-ALK				
		Bicarbonate (as HCO ₃)	71-52-3				
		Calcium (Ca)	7440-70-2				
		Sodium (Na)					
		Potassium (K)	7440-09-7				
		Magnesium (Mg)	7439-95-4				
		Fluoride (F) (Natural-Source)	16984-48-8				
		Boron	7440-42-8				
		Silica	7631-86-9				
		Phosphate (as PO ₄)	PO ₄				
		Ammonia	NH ₃				
Treatment System ^a	General Mineral	Uranium	7440-61-1				
		Strontium	7440-24-6				
Emergent Compounds ^a		n-Nitrosodimethylamine (NDMA)	10595-95-6				
		1,2,3-Trichloropropane	96-18-4				

TABLE 6
GROUNDWATER ANALYTE LISTS

Constituent Group	Analyte Group	Compound/Constituent	CAS	OBJECTIVES			SAMPLE GROUP
				NE/CE Target Zones ¹	Treated Water End Use Evaluation ²	Treatment System Design ³	
Other Permitting ^a	VOCs	1,1,2-Trichloroethane (1,1,2-TCA)	79-00-5				Long List
		1,2-Dichlorobenzene (o-DCB)	95-50-1				
		1,2-Dichloropropane	78-87-5				
		1,3-Dichlorobenzene (m-DCB)	541-73-1				
		1,3-Dichloropropene, Total	542-75-6				
		1,4-Dichlorobenzene (p-DCB)	106-46-7				
		2-Chloroethylvinyl Ether	110-75-8				
		Acetone	67-64-1				
		Acrolein	107-02-8				
		Acrylonitrile (Acritet)	107-13-1				
		Bromoform	75-25-2				
		Dibromochloromethane	124-48-1				
		Chloroethane	75-00-3				
		Bromodichloromethane	75-27-4				
		Ethyl Benzene	100-41-4				
		Bromomethane (Methyl Bromide)	74-83-9				
		Chloromethane (Methyl Chloride)	74-87-3				
		Diisopropyl Ether (DIPE)	108-20-3				
		Methyl Ethyl Ketone (MEK, Butanone)	78-93-3				
		tert-Amyl Methyl Ether (TAME)	994-05-8				
		tert-Butyl Alcohol (TBA)	75-65-0				
		Styrene	100-42-5				
		m,p-Xylene	179601-23-1				
		Total Xylenes (m,p, & o)	1330-20-7				
	General Mineral	Asbestos	1332-21-4				
		Chemical oxygen demand	--				
		pH	12408-02-5				
		Oxidation-reduction potential	--				
		Dissolved oxygen	--				
		Carbon Dioxide	124-38-9				
		Nitrate + Nitrite as Nitrogen (N)	NO3NO2				
		Combined Radium-226 and Radium-228	7440-14-4				
		Gross Alpha	12587-46-1				
		Tritium	10028-17-8				
		Strontium – 90	10098-97-2				
		Gross Beta	12587-47-2				
		Uranium	7440-61-1				

TABLE 6
GROUNDWATER ANALYTE LISTS

Constituent Group	Analyte Group	Compound/Constituent	CAS	OBJECTIVES			SAMPLE GROUP
				NE/CE Target Zones ¹	Treated Water End Use Evaluation ²	Treatment System Design ³	
Other Permitting (continued) ^a	Misc	Total petroleum hydrocarbons	--				Long List (continued)
		Biochemical oxygen demand	--				
		Methane	74-82-8				
		Temperature	--				
		Coliform ^f	--				
		Ethanol	64-17-5				
		Methanol	67-56-1				
		Cyanide	57-12-5				
		2,3,7,8-TCDD (Dioxin)	1746-01-6				
	Pesticides and PCBs	4,4'-DDD	72-54-8				
		4,4'-DDE	72-55-9				
		4,4'-DDT	50-29-3				
		Endosulfan I	959-98-8				
		alpha-BHC	319-84-6				
		Aldrin	309-00-2				
		Endosulfan II	33213-65-9				
		beta-BHC	319-85-7				
		Chlordane	57-74-9				
		delta-BHC	319-86-8				
		Dieldrin	60-57-1				
		Endosulfan Sulfate	1031-07-8				
		Endrin	72-20-8				
		Endrin Aldehyde	7421-93-4				
		Heptachlor	76-44-8				
		Heptachlor Epoxide	1024-57-3				
		gamma-BHC	58-89-9				
		PCB-1016 (as decachlorobiphenyl (DCB))	12674-11-2				
		PCB-1221 (as DCB)	11104-28-2				
		PCB-1232 (as DCB)	11141-16-5				
		PCB-1242 (as DCB)	53469-21-9				
		PCB-1248 (as DCB)	12672-29-6				
		PCB-1254 (as DCB)	11097-69-1				
		PCB-1260 (as DCB)	11096-82-5				
		Toxaphene	8001-35-2				
	SVOCs	1,2-Diphenylhydrazine	122-66-7				
		1,2,4-Trichlorobenzene	120-82-1				
		2-Chlorophenol	95-57-8				
		2,4-Dichlorophenol	120-83-2				
		2,4-Dimethylphenol	105-67-9				
		2,4-Dinitrophenol	51-28-5				
		2,4-Dinitrotoluene	121-14-2				
		2,4,6-Trichlorophenol	88-06-2				
		2,6-Dinitrotoluene	606-20-2				
		2-Nitrophenol	88-75-5				
		2-Chloronaphthalene	91-58-7				
		3,3-Dichlorobenzidine	91-94-1				

TABLE 6
GROUNDWATER ANALYTE LISTS

Constituent Group	Analyte Group	Compound/Constituent	CAS	OBJECTIVES			SAMPLE GROUP
				NE/CE Target Zones ¹	Treated Water End Use Evaluation ²	Treatment System Design ³	
Other Permitting ^a (Continued)	SVOCs (continued)	4-Chloro-3-Methylphenol ^f	59-50-7				Long List (continued)
		2-Methyl-4,6-Dinitrophenol	534-52-1				
		4-Nitrophenol	100-02-7				
		4-Bromophenyl Phenyl Ether	101-55-3				
		4-Chlorophenyl phenyl Ether	7005-72-3				
		Acenaphthene	83-32-9				
		Acenaphthylene	208-96-8				
		Anthracene	120-12-7				
		Benzidine	92-87-5				
		Benzo (a) Anthracene	56-55-3				
		Benzo(a)pyrene	50-32-8				
		Benzo (b) Fluoranthene	205-99-2				
		Benzo (ghi) Perylene	191-24-2				
		Benzo (k) Fluoranthene	207-08-9				
		bis (2-Chloroethoxy) methane	111-91-1				
		bis (2-Chloroethyl) Ether	111-44-4				
		bis (2-Chloroisopropyl) Ether	108-60-1				
		Benzyl Butyl Phthalate	85-68-7				
		Chrysene	218-01-9				
		Dibenzo (a,h) anthracene	53-70-3				
		Diethylphthalate	84-66-2				
		Dimethyl phthalate	131-11-3				
		di-n-Butylphthalate	84-74-2				
		di-n-Octylphthalate	117-84-0				
		Fluoranthene	206-44-0				
		Fluorene	86-73-7				
		Hexachlorobenzene	118-74-1				
		Hexachlorobutadiene	87-68-3				
		Hexachlorocyclopentadiene	77-47-4				
		Hexachloroethane	67-72-1				
		Indeno (1,2,3-cd) Pyrene	193-39-5				
		Isophorone	78-59-1				
		N-Nitrosodi-n-propylamine (NDPA) ^f	621-64-7				
		N-Nitrosodiphenylamine	86-30-6				
		Naphthalene	91-20-3				
		Nitrobenzene	98-95-3				
		Pentachlorophenol (PCP)	87-86-5				
		Phenanthrene	85-01-8				
		Phenol (Carbolic Acid)	108-95-2				
		Pyrene	129-00-0				

TABLE 6
GROUNDWATER ANALYTE LISTS

Constituent Group	Analyte Group	Compound/Constituent	CAS	OBJECTIVES			SAMPLE GROUP
				NE/CE Target Zones ¹	Treated Water End Use Evaluation ²	Treatment System Design ³	
Other Permitting ^a (Continued)	Herbicides	Alachlor (ALANEX) (also UCMR 2 Monitoring-TM 525.2)	15972-60-8				Long List (continued)
		Atrazine (AATREX)	1912-24-9				
		Bentazon (BASAGRAN)	25057-89-0				
		Carbofuran (FURADAN)	1563-66-2				
		2,4-D	94-75-7				
		Dalapon	75-99-0				
		Di(2-ethylhexyl) Adipate	103-23-1				

Permits:	Waste Discharge Requirements (WDR) Permit Only
	National Pollutant Discharge Elimination System (NPDES) Permit Only
	Both NPDES and WDR Permits

COC Chemical of concern
 COPC Chemical of potential concern (RI)
 NE Northern Extraction Area
 CE Central Extraction Area
 RI Remedial Investigation Report
 VOC Volatile organic compound
 SVOC Semivolatile organic compound
 PCBs Polychlorinated Biphenyls

APPLICABILITY TO RESPECTIVE OBJECTIVES

	Directly relevant
	May be relevant to design of treatment system component(s), depends on end use(s) of treated groundwater
	May influence design of treatment system component(s), not expected to be treatment standard
	Based on existing data, not expected to be a concern
	Not applicable

^a Does not include compounds or constituents that are listed in above categories

¹ Assess target zones for extraction in the respective areas

² Characterize the background water quality in reinjection area and/or permit requirements

³ Characterize influent water quality to the groundwater treatment system



FIGURES

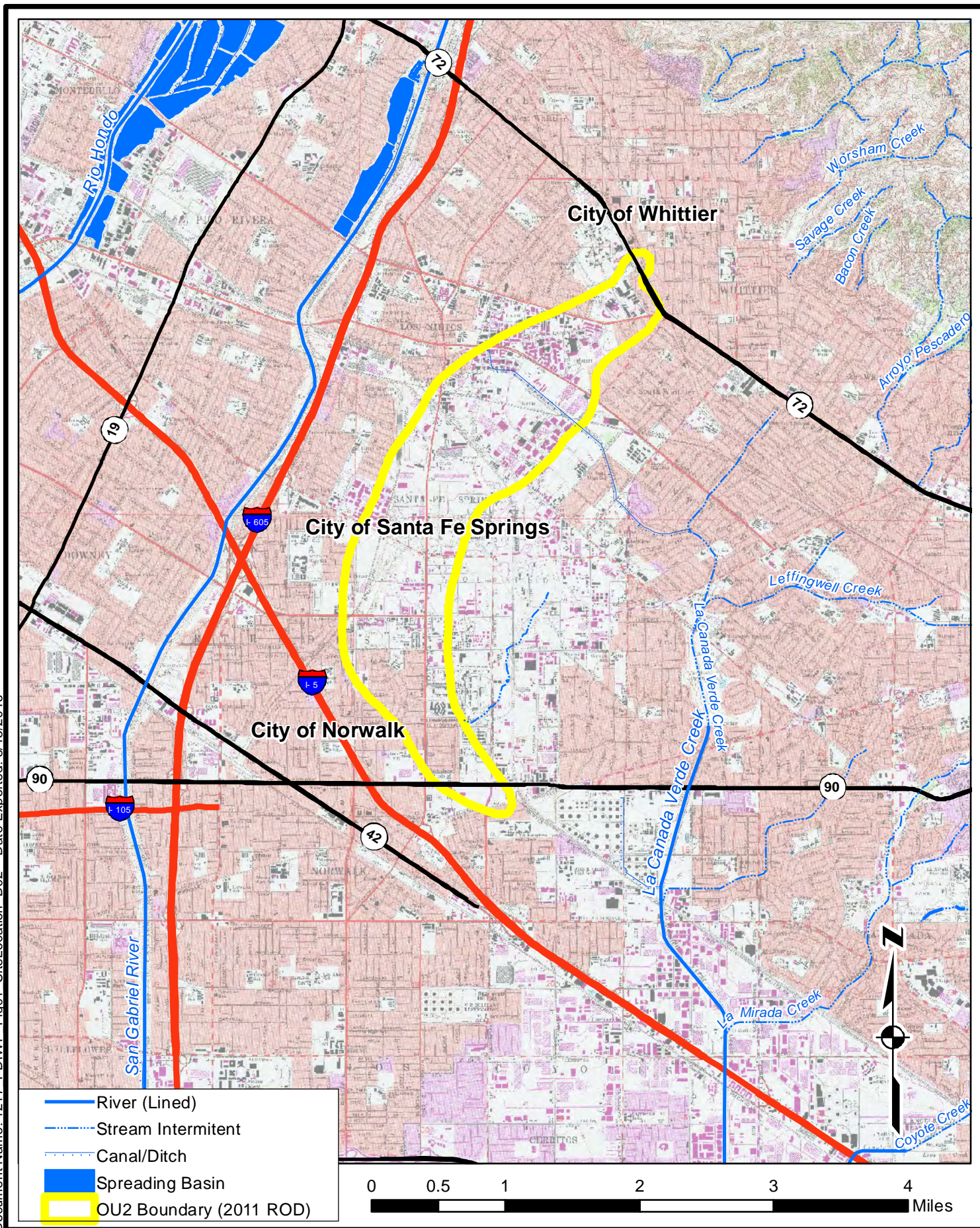


FIGURE 1. SITE LOCATION

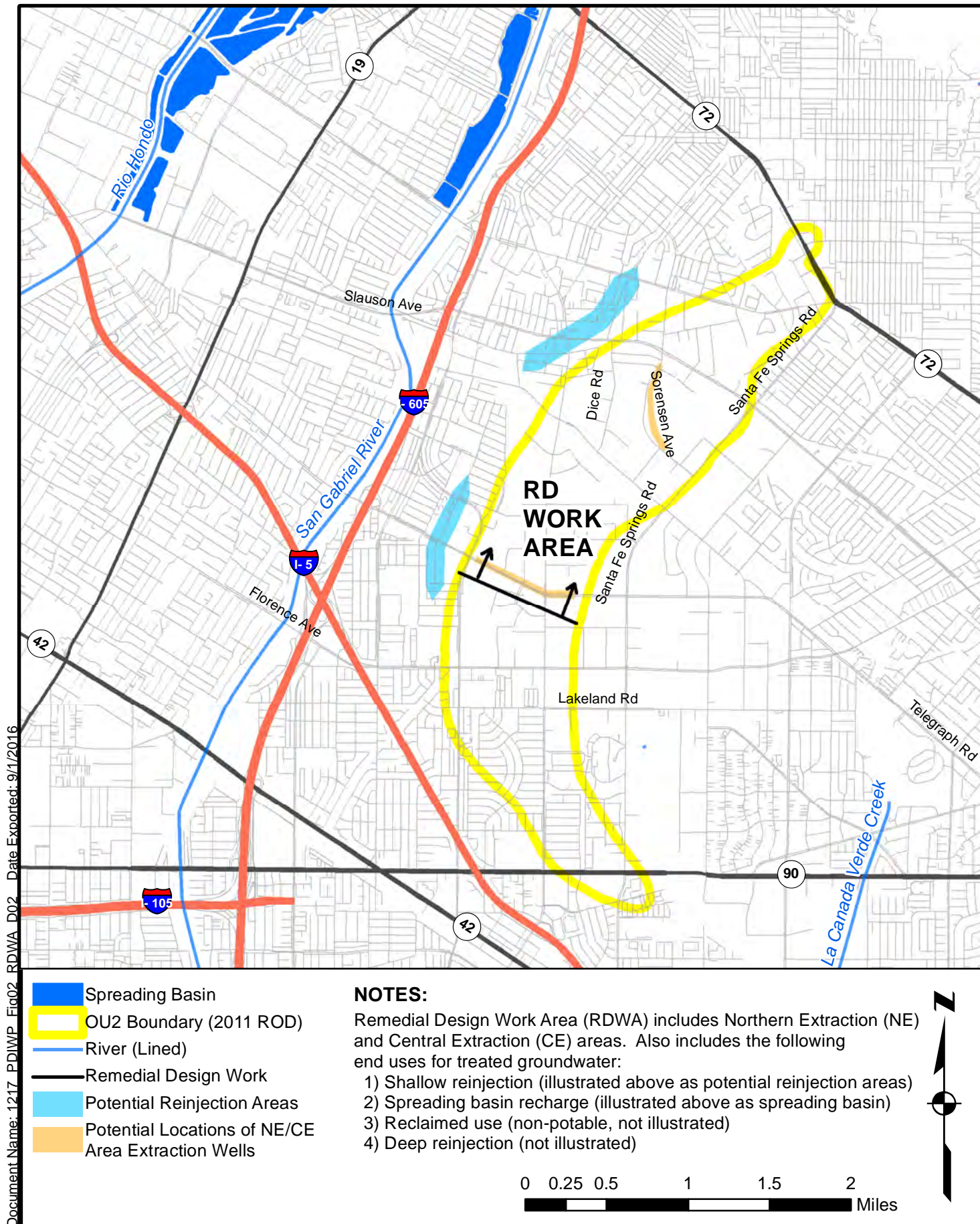
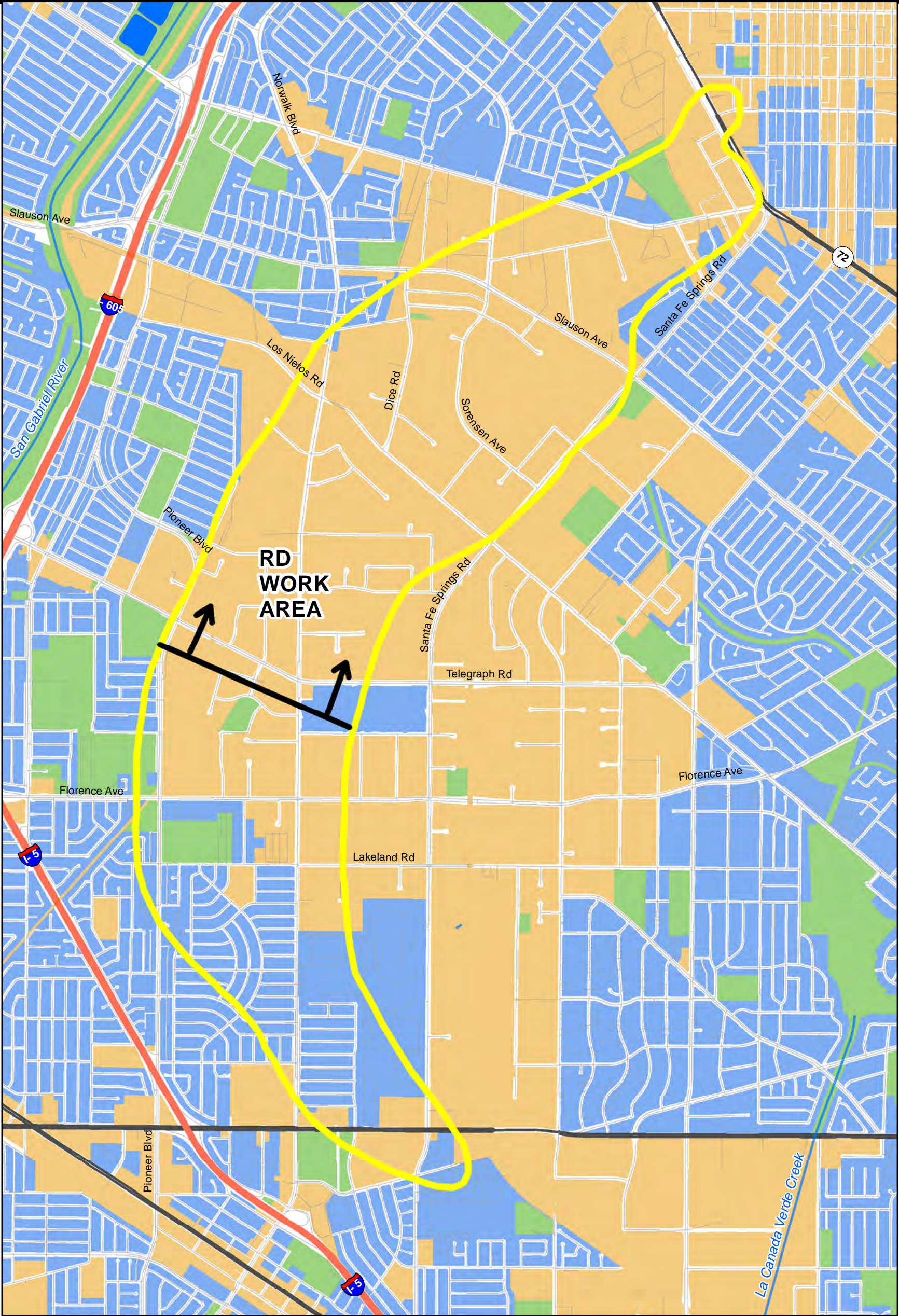


FIGURE 2. REMEDIAL DESIGN WORK AREA

Document Name: 1217_PDWP_Fig03_LandUse_D01 Date Exported: 9/1/2016



- OU2 Boundary (2011 ROD)
- River (Lined)
- Spreading Basin
- Residential
- Schools, Parks and Recreational Areas
- Commercial / Industrial
- Remedial Design Work Area

NOTES:

This dataset was developed in 2009 by the Southern California Association of Governments (SCAG) to provide a Countywide zoning and general plan information. (<http://egis3.lacounty.gov/dataportal/2012/04/10/countywide-zoning/>).

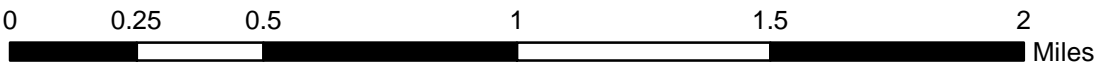
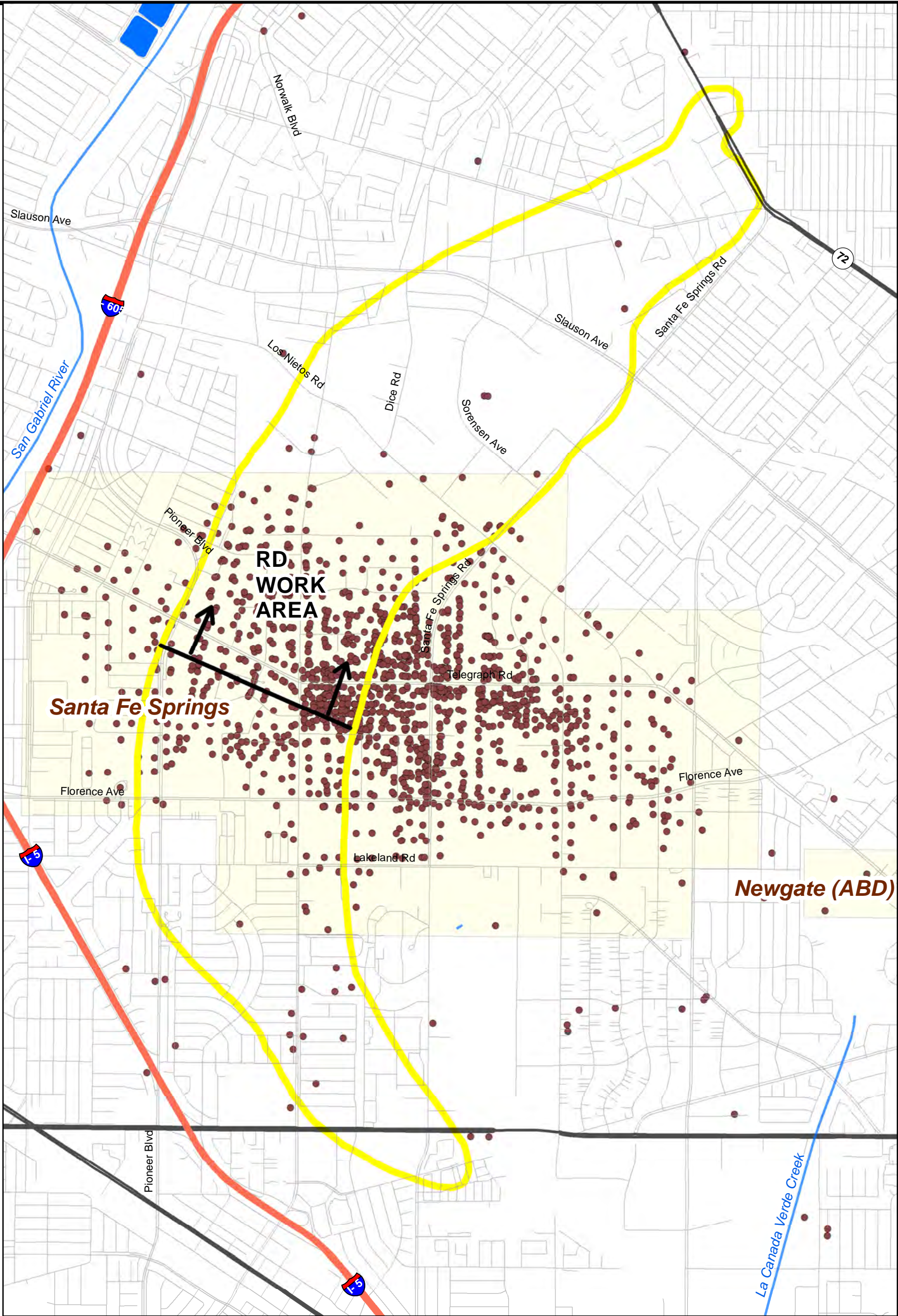


FIGURE 3. LAND USE IN AND AROUND OU2

Document Name: 1217_PDWP_Fig04_Oil_D01 Date Exported: 9/1/2016



- OU2 Boundary (2011 ROD)
- River (Lined)
- Oil Wells (Any Status)
- Oil Field Boundary - Department of Conservation
- Remedial Design Work Area

NOTES:

The California Department of Conservation, Division of Oil, Gas and Geothermal Resources publishes a GIS feature class of well locations and well field locations across the state for use by the public. The data was downloaded from (<http://maps.conservation.ca.gov/doggr/index.html>) as of July 6, 2016.

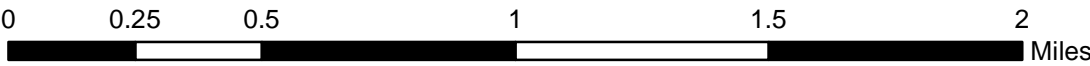
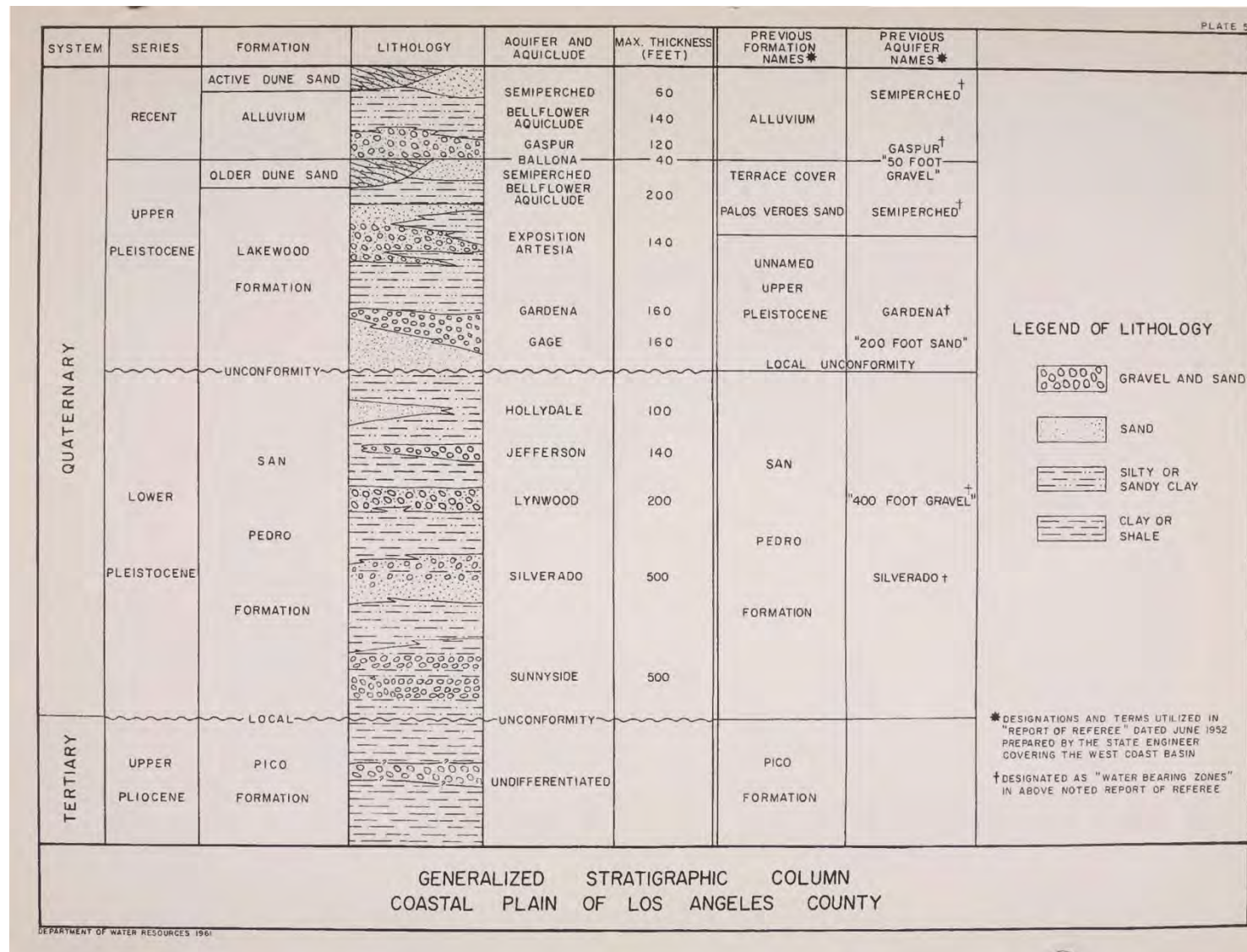


FIGURE 4. SANTA FE SPRINGS OIL FIELD



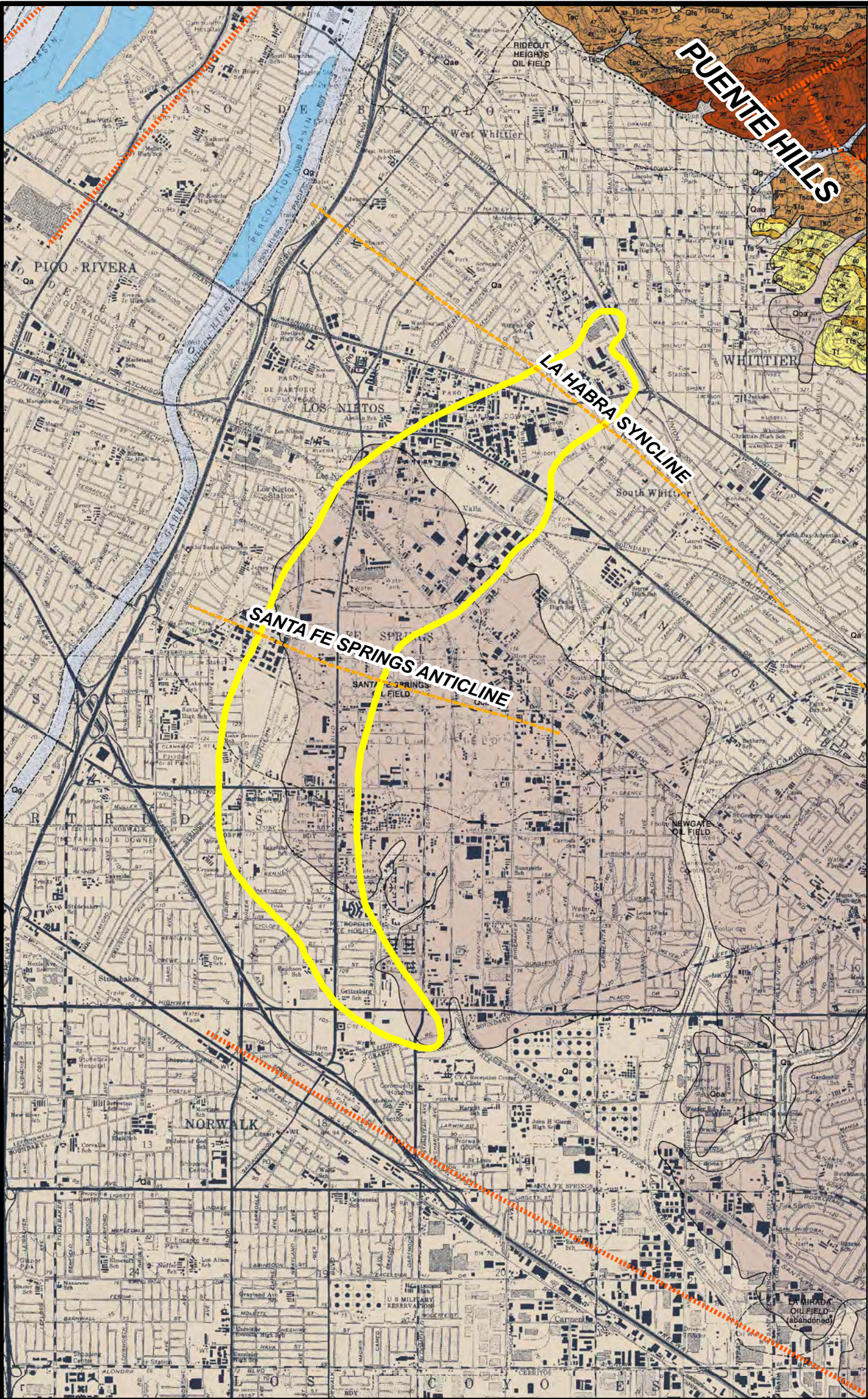
HARGIS + ASSOCIATES, INC.



Reprinted from California Department of Water Resources Bulletin 104, 1961, Plate 5.

FIGURE 5. GENERALIZED STRATIGRAPHIC COLUMN, COASTAL PLAIN OF LOS ANGELES COUNTY

Document Name: 1217_PDWP_Fig06_Geology_D01 Date Exported: 9/1/2016



LEGEND

- af

Qg

Qa

SURFICAL SEDIMENTS
Undissected Alluvial Deposits
- Qls

LANDSLIDE DEBRIS
- Qae

Qoa

OLDER SURFICAL SEDIMENTS
Elevated and dissected alluvial deposits
- UNCONFORMITY
- Qlhc

Qlh

LA HABRA FORMATION
- LOCAL UNCONFORMITY
- Qsp

SAN PEDRO FORMATION
- Tfs

Tf

Tfr

FERNANDO FORMATION
- Tsc

Tscs

Tscg

SYCAMORE CANYON FORMATION
- Tmy

Tm

Tmss

Tms

Tmlv

MONTEREY FORMATION

SOURCES OF INFORMATION:

- Geologic Map:
- Geologic Map of The Whittier & La Habra Quadrangles (Western Puente Hills) Los Angeles and Orange Counties, California
- By Thomas W. Dibblee, Jr., 2001
- Dibblee Geology Center
Map # DF-74, Second Printing
2010
- Other:
- Folds (CH2MHill, 2010 RI Report)
 - Faults (from USGS)

GEOLOGIC SYMBOLS

not all symbols shown on each map

- FORMATION CONTACT

dashed where inferred or indefinite
dotted where concealed
- MEMBER CONTACT

between units of a formation
----- Prominent bed
- CONTACT BETWEEN
SURFICIAL SEDIMENTS

located only approximately in places
- FAULT: Dashed where indefinite or inferred, dotted where concealed,
queried where existence is doubtful. Parrallel arrows indicated inferred
relative lateral movement. Relative vertical movement is shown by
U/D (U=Upthrown site, D=downthrown site). Short arrow indicates
dip of fault plane. Sawteeth are on upper plate of low angle thrust fault.

U

D

25

?

- Strike and dip of
sedimentary rocks

18

inclined

20

inclined
(approximate)

80

overturned

⊕

horizontal

⊥

vertical
- OTHER SYMBOLS:

→

Direction of
landslide movement

outline of water bodies
shown on map

○

water well

⊙

oil well

⊙

springs

OU2 Boundary (2011 ROD)

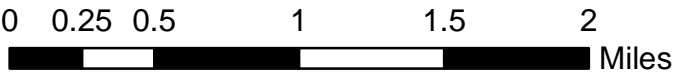


FIGURE 6. MAIN GEOLOGIC FEATURES



Water Level Monitoring
Los Angeles County Department of Public Works

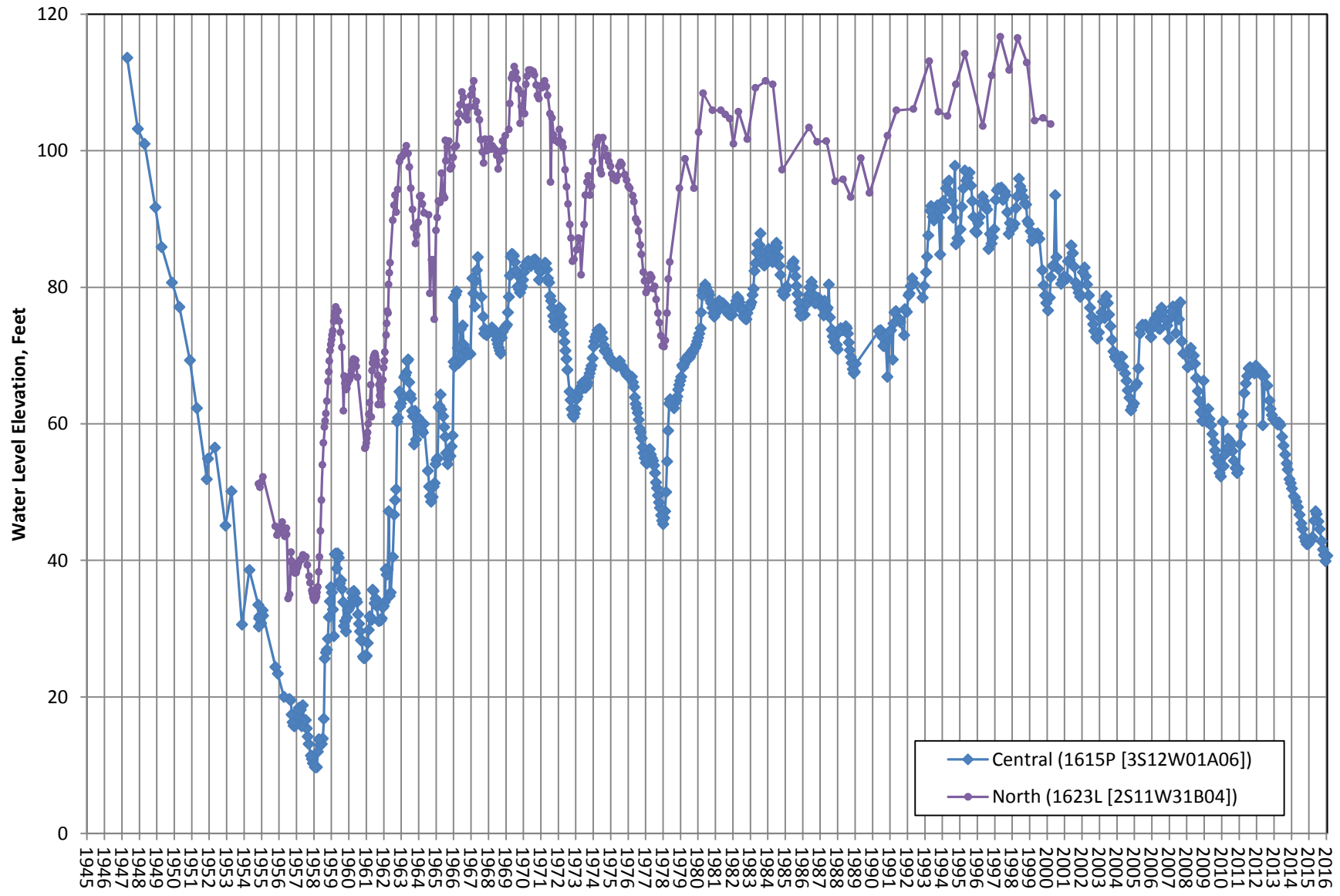
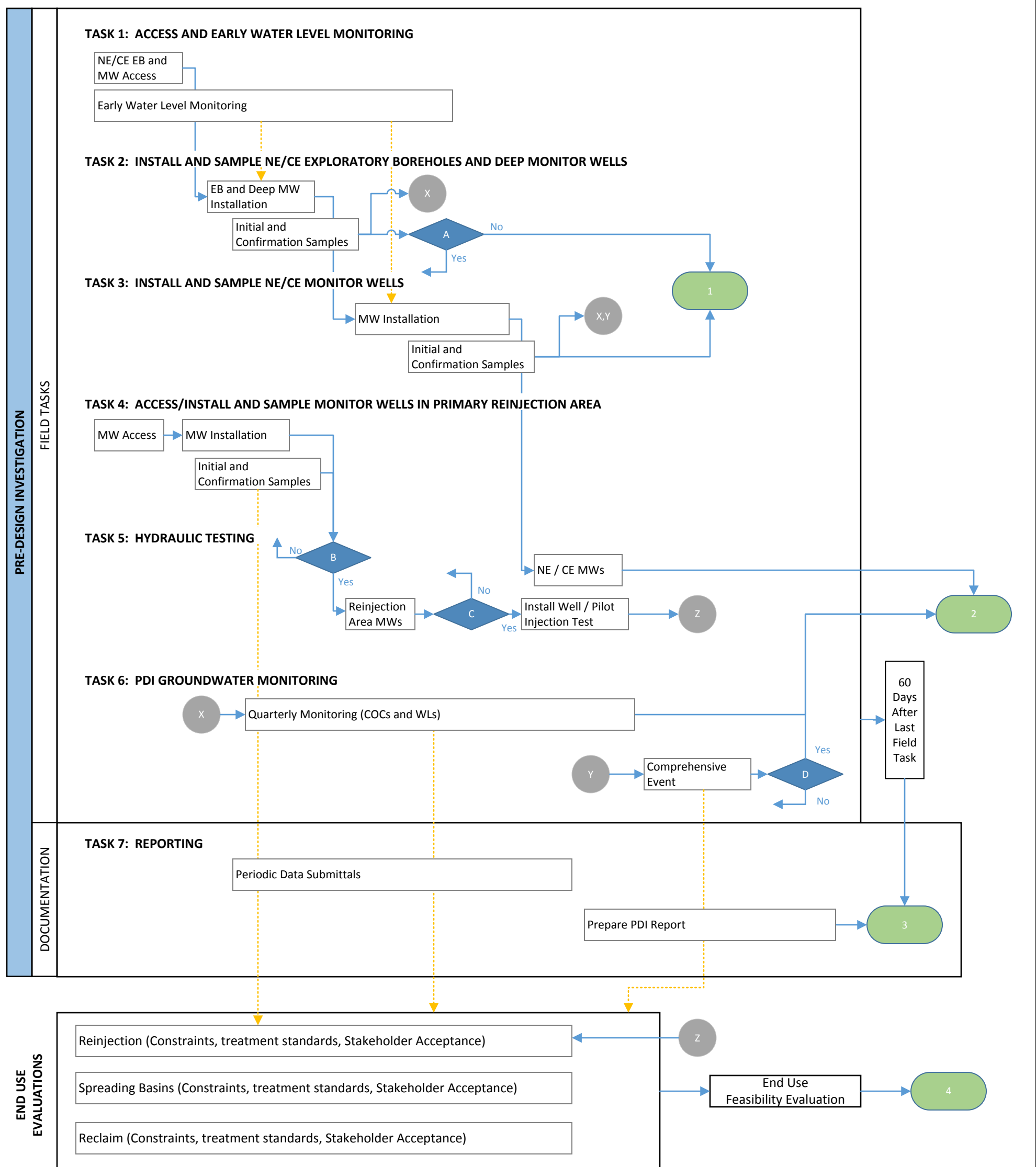







FIGURE 7. HISTORICAL GROUNDWATER HYDROGRAPHS

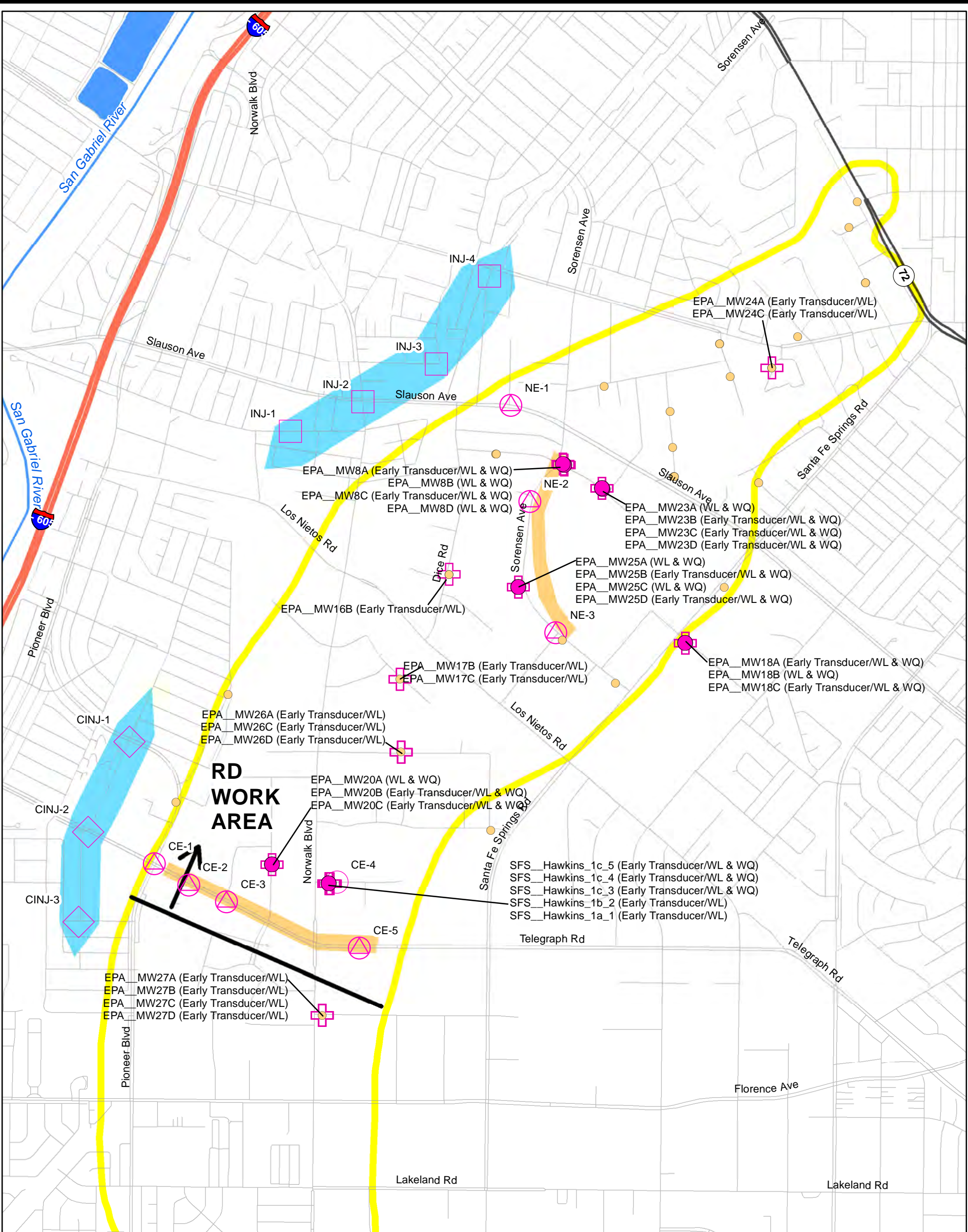


EXPLANATION AND ACRONYMS					
NE	Northern Extraction Area	COC	Chemical of Concern	EB	Exploratory Borehole
CE	Central Extraction Area	PDI	Pre-Design Investigation	MW	Monitor Well
WL	Water Level				
	On Page Flow chart connector		Flow chart decision		Flow chart terminator
	Flow chart key predecessor/successor task				Flow chart information

DECISIONS AND TERMINATIONS		
A	Are additional deep PDI monitor wells required?	If yes, install per PDI plan.
B	Is subject reinjection area viable based on water quality results?	If yes, proceed to next step.
C	Is subject reinjection area viable based on hydraulic testing results?	If no, consider evaluating alternate reinjection area.
D	Results consistent?	If no, conduct additional sampling to resolve.
1	Define target zones of NE and CE areas based on COC results from PDI and selected existing monitor wells.	
2	Estimate extraction rates and influent water quality to treatment system (outside PDI, part of remedial design).	
3	Submit PDI Report 60 days after final PDI Field Task Completed.	
4	Recommend end use(s) for treated groundwater and obtain EPA concurrence (outside PDI).	

FIGURE 8. PRE-DESIGN INVESTIGATION TASKS

Document Name: 1217_PDIWP_Fig09_PDIOverview_D02 Date Exported: 9/1/2016



- Spreading Basin
- OU2 Boundary (ROD)
- Remedial Design Work Area
- Potential Locations of NE/CE Area Extraction Wells
- Potential Reinjection Areas
- PDI Early Transducer Well
- PDI NE/CE EB and MW Cluster
- PDI CE Shallow MW
- PDI Existing Monitor Well - WQ & WL Data Collection
- PDI Candidate Reinjection Shallow MW
- PDI Contingency Candidate Reinjection Shallow MW
- Existing Monitor Well - WL Data Collection (Not labeled)

NOTES:

Remedial Design Work Area (RDWA) is north of vicinity of Telegraph Road and includes Northern Extraction (NE) and Central Extraction (CE) areas. Also includes the following end uses for treated groundwater:

- 1) Shallow reinjection (illustrated above as potential reinjection areas)
- 2) Spreading basin recharge (partially illustrated above as spreading basin)
- 3) Reclaimed use (non-potable, not illustrated)
- 4) Deep reinjection (not illustrated)

Existing MWs are EPA or Water Replenishment District MWs in or near RD Work Area

MW = Monitor Well WL = Water Level
EB = Exploratory Borehole WQ = Water Quality
PDI = Pre-Design Investigation

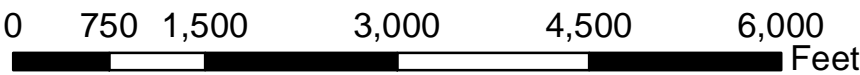


FIGURE 9. SUMMARY OF PRE-DESIGN INVESTIGATION ACTIVITIES